KRA

KIRSTEN REITE
ARCHITECTURE

PROJECT:	**Haida Gwaii Pharmacy Renovation Project**
DATE:	March 26th, 2025
KRA project no.:	2024-025 **ADDENDUM NO.2**

This addendum is to be read with and constitutes part of the tender document.

Instructions:

1. Amend your copy of the tender/quotation/proposal in accordance with the details below.

Details of the Addendum:

Part 1 GENERAL

1.1 General

.1 This Addendum varies the Invitation to Tender Documents titled " HAIDA GWAII - HGH Pharmacy NAPRA Upgrade" dated March 5th, 2025.

.2 This Addendum shall form part of the Contract Documents and is to be read, interpreted and coordinated with all other parts. The cost of all work contained herein shall be included in the Contract sum. The following revisions supersede the information contained in the original specifications and drawings issued for the above-named project.

.3 This Addendum is one hundred and seventy-six (176) pages in total.

1.2 Tender Inquiries

.1 Is there mechanical drawings?

[KRA Response]: *Yes, see attached mechanical drawings issued for tender.*

.2 Will the virtual site meeting recording be released soon?

[KRA Response]: *A link to the recording of the virtual site walkthrough meeting was included in addendum 01.*

.3 Please provide mechanical drawing set? In bid documents, there were 2 copies of electrical along with architectural drawings.

[KRA Response]: *See attached mechanical drawings and specifications issued for tender.*

.4 Could we have a 1- or 2-week extension to tender?

[KRA Response]: *The bid closing date will be extended to Wednesday, April 16th, 15:00 PST. See attached revised Section 00 11 13 Advertisement for bids.*

.5 Pease confirm Enquiry deadline.

[KRA Response]: *Tender inquiries can be submitted until Wednesday, April 9th, end of day.*

.6 Will the recording of this initial virtual site visit be uploaded?

[KRA Response]: *A link to the recording of the virtual site walkthrough meeting was included in addendum 01.*

1.3 Modifications to the Tender Set – Architectural

Drawings

.1 Sheet A2.100 Level 01 - Proposed Floor Plan and Ceiling Plan – Refer to attached revised drawing sheet.

a) **ADD** gasketed ceiling-mounted access panel.

b) **ADD** wall-mounted access panel.

Specifications

.1 Section 00 11 13 Advertisement for Bids Part 2. Pre-Bid Inquiries – Refer to attached revised specification section.

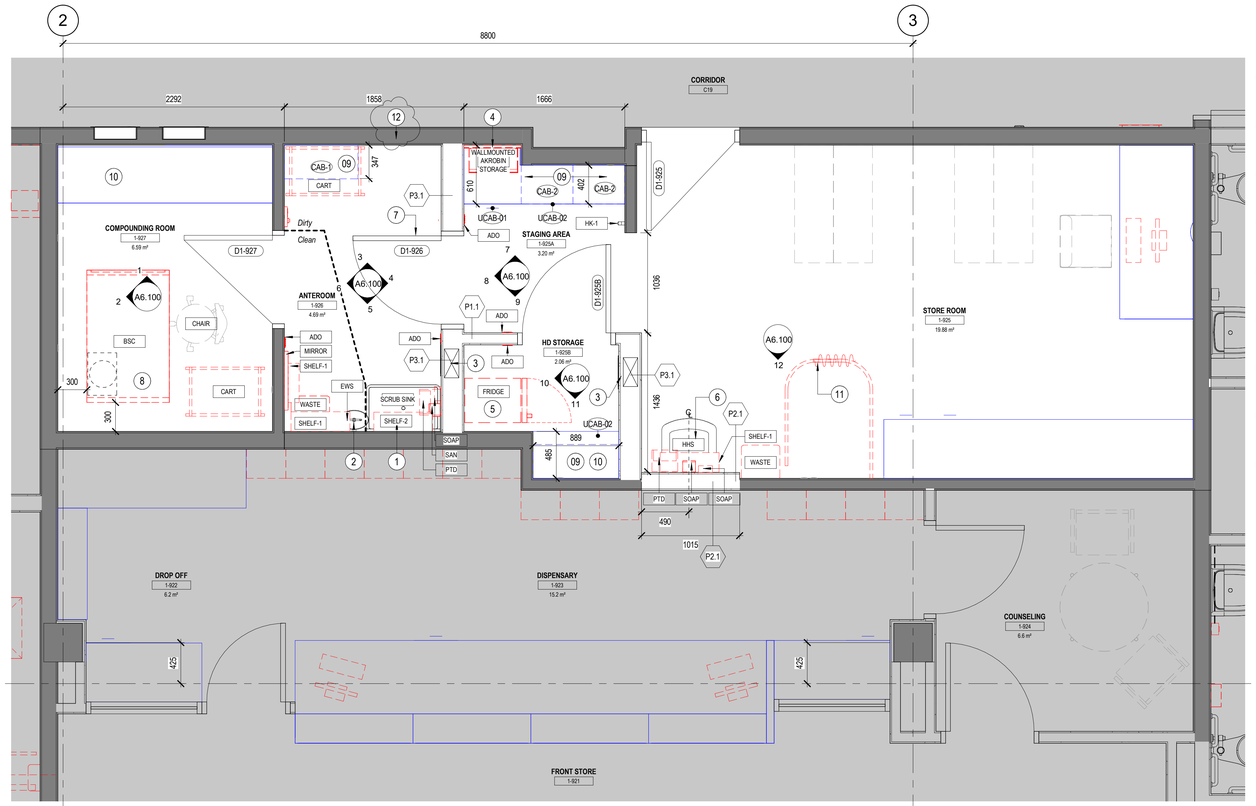
a) **REVISE** bid close to April 16th, 2025.

.2 Section 00 21 13 Instructions to Bidders Part 3. Pre-Bid Site Visit – Refer to attached revised specification section.

a) **REMOVE** requirement for signing of attendance sheet for virtual tender walkthrough meeting. Instead, interested bidders will be required to confirm viewing of the virtual meeting recording.

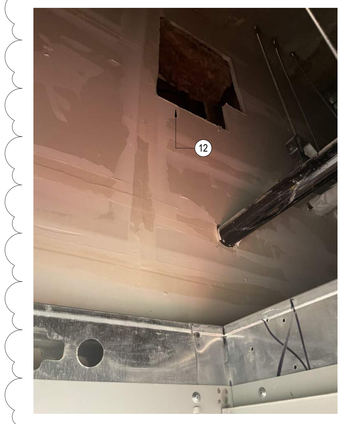
Attachments:

- Architectural drawing sheet A2.100 Level 01 - Proposed Floor Plan and Ceiling Plan (2025-03-26)
- Specifications Section 00 11 13 Advertisement for bids (2025-03-26)
- Specifications Section 00 21 13 Instructions to Bidders (2025-03-26)
- Mechanical drawings issued for tender (2025-03-03)
- Mechanical specifications issued for tender (2025-03-03)



1 | LEVEL 01 - PROPOSED PLAN

A2.100 | SCALE: 1 : 25

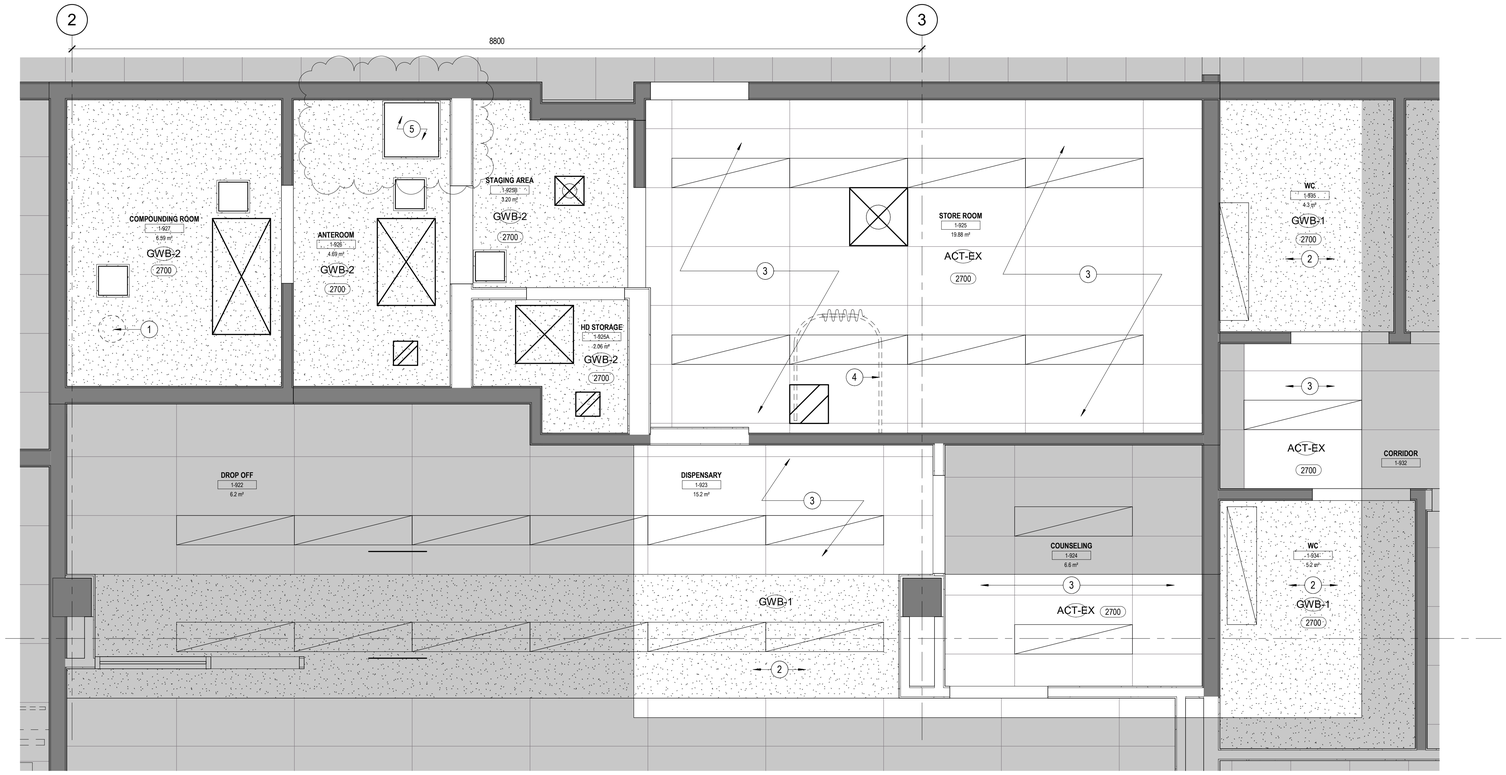


KEYNOTES

1. RELOCATED SCRUB SINK WITH AUTOMATIC FAUCET AND EXISTING ACCESSORIES. REFER TO MECHANICAL.
2. RELOCATED EMERGENCY EYEWASH STATION. REFER TO MECHANICAL.
3. LOW-LEVEL EXHAUST DUCT & GRILLE. REFER TO MECHANICAL.
4. WALLMOUNTED AKROBIN STORAGE SYSTEM. PROVIDE SUFFICIENT BACKING.
5. PHARMACEUTICAL FRIDGE. ALARMED AND CONNECTED TO BMS.
6. HAND HYGIENE SINK & WALL-MOUNTED ACCESSORIES. REFER TO INTERIOR ELEVATIONS AND MECHANICAL DRAWINGS & SPECIFICATIONS.
7. EXISTING DOOR, FRAME AND HARDWARE RELOCATED.REFER TO ELECTRICAL.
8. DUCTED BIO-SAFETY CABINET. REFER TO MECHANICAL AND OWNER'S PRODUCT SHEET. PROVIDE SEISMIC RESTRAINT ANCHORS AS REQUIRED.
9. STAINLESS-STEEL UPPER CABINET. PROVIDE BACKING. REFER TO INTERIOR ELEVATIONS AND SPECIFICATIONS.
10. STAINLESS-STEEL COUNTER C/W WALL BRACKETS. PROVIDE BACKING. REFER TO INTERIOR ELEVATIONS AND SPECIFICATIONS.
11. WALL-MOUNTED PRIVACY CURTAIN TRACK. REFER TO SPECIFICATIONS.
12. PROVIDE WALL-MOUNTED ACCESS PANEL (600 x 600mm) AT EXISTING WALL OPENING TO ACCESS EXISTING VAV BOX IN CORRIDOR.

PLAN LEGEND

- SHADED HATCHING DENOTES EXISTING AREAS, OUT OF SCOPE.
- SHADED HATCHING DENOTES EXISTING WALLS. PATCH AND MAKE GOOD WALLS AFFECTED BY RENOVATION SCOPE.
- SHADED LINE DENOTES EXISTING
- SOLID LINE DENOTES NEW CONSTRUCTION
- RED DASHED LINE DENOTES EQUIPMENT.
- SHADED DASHED LINE DENOTES FURNITURE NOT IN CONTRACT.



2 | LEVEL 01A - RCP PROPOSED

A2.100 | SCALE: 1 : 25

KEYNOTES

1. DUCTED BIO-SAFETY CABINET (TYPE II B2). REFER TO MECHANICAL AND OWNER'S PRODUCT SHEET.
2. REINSTATE EXISTING GWB BULKHEAD/ CEILING AND EXISTING CEILING FIXTURES FOLLOWING DUCTING WORKS. MATCH EXISTING AND MAKE GOOD.
3. REINSTATE EXISTING ACT CEILING AND EXISTING CEILING FIXTURES FOLLOWING DUCTING WORKS. REPLACE ANY DAMAGED TILES, GRIDS OR FIXTURES.
4. CEILING-MOUNTED PRIVACY CURTAIN TRACK. REFER TO SPECIFICATIONS.
5. PROVIDE GASKETED ACCESS PANEL TO ACCESS EXISTING VAV BOX IN CORRIDOR.

REFLECTED CEILING LEGEND

- SHADED HATCHING DENOTES EXISTING AREAS, OUT OF SCOPE.
- SHADED LINE DENOTES EXISTING
- SOLID LINE DENOTES NEW CONSTRUCTION
- DASHED LINE DENOTES EQUIPMENT. REFER TO EQUIPMENT SCHEDULE FOR RESPONSIBILITY.
- BLUE LINE DENOTES LOCATION OF MILLWORK.

CEILING TYPES

- **ACT-1** - 610MM X 1220MM ACOUSTIC CEILING TILE
- **GWB-1** - GYPSUM WALL BOARD PAINTED WITH PT-1
- **GWB-2** - GYPSUM WALL BOARD PAINTED WITH PT-2

ELECTRICAL FIXTURES

- SQUARE LIGHT FIXTURE
- LINEAR LIGHT FIXTURE
- SMOKE DETECTOR
- HEAT DETECTOR
- FIRE ALARM SPEAKER
- EXIT SIGN

MECHANICAL FIXTURES

- SQUARE RECESSED DIFFUSER
- MECHANICAL GRILLE

ARCHITECTURAL FIXTURES

- SQUARE RECESSED AND GASKETED ACCESS PANEL

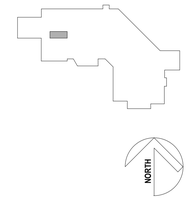
NOTE: LEGEND IS FOR REFERENCE ONLY. REFER TO MECHANICAL, ELECTRICAL DOCUMENTS FOR EXACT FIXTURE.

KRA
KIRSTEN REITE ARCHITECTURE
939 EAST HASTINGS STREET
VANCOUVER BC, V6A 0H1
WWW.KRARCHITECTURE.CA

CONSULTANTS:

MECHANICAL: ROCKY POINT
ELECTRICAL: ATKIN RÉALIS
STRUCTURAL: BUSH BOLMAN PARTNERS

KEY PLAN



Issued For:

NO	ISSUANCE	DATE
1	ISSUED FOR INTERNAL REVIEW	2024-09-24
2	ISSUED FOR 90% CD REVIEW	2024-10-15
3	ISSUED FOR 100% CD	2024-11-08
4	ISSUED FOR TENDER	2025-03-03
5	ISSUED FOR ADDENDUM 02	2025-03-26

Project Title

HAIDA GWAII PHARMACY RENOVATION PROJECT

3209 OCEANVIEW DRIVE, DAAJING GIIDS, BC,CANADA, V0T 1S0

Drawing Title

LEVEL 01 - PROPOSED FLOOR PLAN AND CEILING PLAN

Sheet Information

Date:	2025-03-26
Project Number:	KRA PROJECT #2024-025
Drawn:	LC
Checked:	RLB
Approved:	SG

Stamp

Drawing No.

A2.100

2025-03-26 10:11:37 AM
Autodesk Docs://HGH Pharmacy Upgrade/HGH_Pharmacy_Upgrade_Arch_R2022.rvt

Part 1.1: DIVISION 00
Procurement and Contracting Requirements

For use with CCDC 2-2020 Stipulated Price Contract

00 11 13 - ADVERTISEMENT FOR BIDS

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1. BID CALL

.1 *Northern Health Authority*
will receive bids for this *Project* on or before *15:00 (PST)* on *April 16th, 2025*
(unless modified by addendum) at:

☒ .1a

☐ .1b *BC Bid*

.2 The official bid closing time will be determined by the [~~*reception desk clock*~~] [*online system*]
at the bid closing location.

~~.3 ☒ This bid call is by invitation only. The following Bidders have been invited to bid:~~

~~.3.1 Submit bids only in the name indicated in the letter of invitation to bid. Bids submitted in a name different to that indicated in the invitation, or from Bidders not invited to bid per 00 11 13 1.3, will be returned unopened, or if inadvertently opened, will be rejected and deemed as non-compliant.~~

.4 Bid Opening Process:

Bids will be opened privately, immediately after the time for receipts of Bids.

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.5 Unofficial bid results will be disclosed promptly to all Bidders. Such disclosure will not imply that the bids received are compliant or that a contract will be awarded to the lowest or any Bidder.

2. BID DOCUMENT AVAILABILITY

.1 Bid Documents are available in electronic form. It does not confer a license to use the Bid Documents for any other purpose. Bid Documents may be obtained from:

BC Bid

.2 ~~☒ Bid Documents are available in hard copy form. It does not confer a license to use the Bid Documents for any other purpose. Hard copy Bid Documents may be obtained at :~~

3. PROJECT DESCRIPTION

Interior alterations to existing pharmacy suite and exterior works to suit NAPRA standards.

END OF SECTION

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00 21 13 INSTRUCTIONS TO BIDDERS

1. DOCUMENTS

1.1 DOCUMENTS

.1 Carefully examine the following information. Failure to follow these instructions may result in bid disqualification.

.2 Project information:

.1 Project / Contract Name: Haida Gwaii Pharmacy Renovation Project

.2 Project / Contract No.: NHA: N671370001; KRA: 2024-025

.3 *Owner*: Northern Health Authority

.4 Project Address: 3209 Oceanview Drive
Daajing Giids, BC
V0T 1S0

.3 Examine the Bid Documents and promptly notify the person designated to receive inquiries of any perceived errors, omissions, conflicts or discrepancies in the Bid Documents.

1.2 BID DOCUMENTS

(a) BCDC 2 - 2022, Part 1.1 Division 00 11 13 Advertisement for Bids;
(b) BCDC 2 - 2022, Part 1.1 Division 00 21 13 Instructions to Bidders; 00 73 16 Insurance Requirements; 00 73 63 Contract Security Requirements;
(c) BCDC 2 - 2022, Part 1.1 Division 00 41 13 Bid Form and Appendices;
(d) CCDC 2 - 2020, Articles of Agreement;
(e) CCDC 2 - 2020, General Conditions;
(f) BCDC 2 – 2022, Part 1.2 Supplementary Conditions;
(g) BCDC 2 – 2022, Part 1.3 Project Specific Amendments, if any;
(h) General Requirements;
(i) Drawings and Specifications;
(j) Appendices, if any;
(k) Addenda.

1.3 CONTRACT DOCUMENTS

.1 Upon award of contract the Contract Documents consist only of (b) to (k) above. The *Owner* will prepare two copies of the Contract.

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2. PRE-BID INQUIRIES

.1 Direct inquiries relating to Bid Documents, only to the *Consultant/Owner* at:

BIds and Tenders

.2 Submit inquiries as early as possible in the bid period and not less than 5 Working Days before the bid closing time. Inquiries received after this time may not receive a response.

3. PRE-BID SITE VISIT

~~☒ .1 There will not be a pre-bid site visit for the Project.~~

❒ .2 There will be pre-bid site visit for the Project.

~~❒ 2.1 Mandatory Site Visit~~

~~Failure of a Bidder's representative to attend and sign the attendance sheet will cause the Bid to be rejected as non-compliant.~~

❒ 2.2 Optional Site Visit

A pre-bid site visit has been scheduled for 10:00 local time on March 18th and 25th , 20 25 . Attendees will meet at

Virtual Site Visit on Tuesday, March 18th: Teams conference call for opportunity to review the project. A power point presentation will be presented. Attendance will be optional, but all interested bidders will be required to confirm viewing of the meeting recording which will be made available in an addendum.
Optional in-person site visit on Tuesday, March 25th: Main Entrance of the existing Hospital.

~~Bidders will be required to sign an attendance sheet during the meeting. Names of Bidders attending will be issued by addendum.~~

Issues arising from the pre-bid site visit will be addressed as required in an addendum to the Bid Documents. No meeting minutes will be issued. Bidders may not rely upon any information given verbally or otherwise at the pre-bid site visit and that is not confirmed by addendum.

Bidders visiting the Place of the Work must be accompanied at all times by a representative of the *Owner*.

Bidders visiting the Place of the Work must provide their own personal protective equipment.

❒ 2.3 *Owner* Requirements of Site Visit

Contractors that are attending the Teams conference call are to confirm their attendance to Jay.Dupras@northernhealth.ca by 2:00 pm on March 12th. Registered contractors will then be sent the meeting invite.
Contractors that would like to attend the optional in-person walk through are to confirm their attendance to Jay.Dupras@northernhealth.ca by 2:00 pm on March 19th.

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4. PARTICULARS AFFECTING BID PRICE

4.1 MATERIALS

.1 Establish the Bid Price based on the use of materials specified in Drawings and Specifications.

.2 Proposed substitutions to materials specified will be considered during the bidding period only if full descriptive data are submitted in writing to the *Consultant/Owner* at least *7* Working Days before the bid closing date.

.3 Approved substitutions will be incorporated in the Drawings and Specifications by issuance of an Addendum.

4.2 CONDITIONS RELATED TO THE WORK

.1 Become familiar with the site and existing conditions prior to submitting a bid and make allowances for conditions related to the Work.

.2 Claims for an increase in Contract Price or Contract Time arising from observable conditions will be rejected by the *Owner*.

4.3 TAXES

.1 Include in bid price all taxes and customs duties in effect at the time of the bid closing, except for Value Added Taxes as defined in the CCDC standard form of contract.

5. ADDENDA

.1 Addenda may be issued to modify the Bid Documents in response to Bidder inquiries or as may be considered necessary.

.2 All addenda issued during the bid period will become part of the Bid Documents.

.3 No addenda will be issued later than 3 Working Days before the bid closing time, unless absolutely necessary.

.4 Each Bidder must ascertain before bid submission that it has received all addenda issued during the bid period and must indicate the addendum number(s) of all addenda received with their bid submission.

6. INTERPRETATION AND MODIFICATION OF BID DOCUMENTS

1. If an inquiry requires an interpretation or modification of the Bid Documents, the response to that inquiry will be issued in the form of a written Addendum only, to ensure that all Bidders base their bids on the same information.
2. Replies to inquiries or interpretations or modifications of the Bid Documents made by e-mail, verbally, or in any manner other than a written Addendum, will not form part of the Bid Documents and will not be binding.

7. BID DEPOSITORY

❒ .1 This Project will *not* use BidCentral Online Bidding for Subcontractors ("BOBS"), a bid depository system.

☒ .2 This Project will use BidCentral Online Bidding for Subcontractors ("BOBS"), a bid depository system.

❒ 2a. The following subcontractors must submit their bid through BOBS and provide bonding per the Rules of Procedure ("Rules"):

❒ 2b. The following subcontractors must submit their bid through BOBS and do not require bonding:

.1 The date and time for the BOBS closing will be not less than two (2) working days prior to General Contractor bid closing and up to 3:00 PM on the date specified, subject to the Rules.

.2 The Rules of Procedure for BOBS, in force at the bid closing time, will apply.

.3 Subcontractors listed must submit their bids through BOBS via the specified method as defined in BidCentral (https://www.bidcentral.ca/online-bidding-for-subcontractors/).

.4 Where stipulated in section 2a, BOBS requirements in the Project Documents, and as required under the Rules, the subcontractor must provide a bond. Such bond must conform to the requirements of the Rules.

.5 General Contractors must confirm their Intention to Bid no later than two (2) Working Days (to the hour) prior to the BOBS closing date and time as per the requirements in the Rules for BOBS.

.6 Notwithstanding the requirements for exclusion of work contained in the Rules, ensure all Work described in the Bid Documents is included in the Bid Price.

.7 Where required by 2a and when requested to do so the Bidder agrees to provide the *Owner* with proof of Subcontractor bonds within ten (10) Working Days of Contract award.

.8 Only General Contractor Bids which list Trade Contractor Bids submitted in accordance with the Rules of Procedure for BOBS for those sections or divisions specified, will be subject to a recommendation of acceptance from the Bid Calling Authority to the *Owner* and any others will be rejected.

Reset

❒ Bid Submission: ONLINE BIDDING SYSTEM SUBMISSIONS

8E. COMPLETION OF BID FORM

.1 All Bidders should familiarize themselves regarding online bidding requirements relating to system failure, functionality of the online system, Exclusion of Liability, Terms and Conditions for Online Bidding and Privacy Policy.

.2 Bidders must complete the bid on the Bid Form included in the Online Bidding System and execute in accordance with provisions of Clause 9E of the Instructions to Bidders - EXECUTION OF THE BID.

.3 If required, state the number of weeks within which the Bidder will achieve *Ready-for-Takeover*.

.4 If required, indicate receipt of Addenda.

9E. EXECUTION OF THE BID

.1 Execute the Bid Form by the method of the Bidder's identification and authentication as designated in the On-line Bidding System.

10E. DELIVERY OF THE BID

.1 All Bids must be submitted through the On-line Bidding System not later than the date and time specified for the On-line Bidding System closing. Bids submitted after On-line Bidding System closing time will not be allowed by the On-line Bidding System.

.2 The time as indicated on the On-line Bidding System will be the official time for the On-line Bidding System closing.

.3 The *Owner* is neither liable nor responsible for costs incurred by Bidders in the preparation, submission or presentation of the bid. Bidders will be required to accept on-line the Terms and Conditions of the On-line Bidding System in Clause 13.2 Terms and Conditions.

.4 Bid documents become the property of the *Owner.*

11E. BID MODIFICATION AND WITHDRAWAL

.1 Bidders must comply with procedures for electronic bid modification and withdrawal established by the online bidding system.

12E. BID SECURITY REQUIREMENTS

.1 Digitally Verified Bid Bonds must be submitted through the online bidding system. Digitally verified Bid Bonds must be provided by the Bidder's Surety representative through one of the ebond providers assessed by the Surety Association of Canada. Bid Bonds must include a clearly legible signature and seal. The attachment by the Bidder of the Bid Bond with the on-line creates the lawful act of validating the bond by the Bidder.

.2 Ensure the Bid Form is accompanied by a bid bond in the amount of ten percent (10%) of the Bid Price, Certified cheques and guaranteed letters of credit will **not** be accepted.

.3 Ensure the bid bond is issued on a CCDC 220 Bid Bond form or other form approved by the Surety Association of Canada and issued by a Surety acceptable to the *Owner.*

.4 If a successful Bidder declines to enter a Contract within the period set out in the Bid Form, or a further agreed period of time, the principal and surety will be required to pay to the *Owner* a sum equivalent to the difference between the principal's bid and the accepted bid or ten percent (10%) of the principal's bid, whichever is the lesser.

.5 The bid bond must name the *Owner* as specified in the bid document as the oblige and must be signed, sealed, and dated by both Bidder and surety.

00 21 13 (con't) INSTRUCTION TO BIDDERS

13. BID ACCEPTANCE

.1 The lowest or any bid will not necessarily be accepted.

.2 The *Owner*, at its sole discretion, may accept or reject any or all of the Alternative Prices submitted in the Bid Documents. Alternative Prices will not be considered in determining the successful Bidder.

.3 Alternative Prices listed in the Bid Documents will remain open for acceptance by the *Owner* for the period stated in the Bid Documents, from the time and date specified for closing of bids.

.4 Bids which contain qualifying conditions or otherwise fail to conform to these Instructions to Bidders may, at the sole discretion of the *Owner*, be disqualified or rejected.

.5 The *Owner* retains the separate right to waive minor irregularities in the Bid Form if such irregularities have not provided the Bidder with a competitive advantage.

.6 In the event a single bid is received, the *Owner* may open the bid privately without reference to the Bidder. If the bid is opened and it is in excess of the *Owner*'s budget, the *Owner* reserves the right to re-issue the Bid Documents for new public re-bid without revisions being made to the Bid Documents and without disclosing the single Bid Price. The *Owner* reserves the right to accept or reject a single bid.

.7 The *Owner* has the right to enter into over-budget negotiations with the lowest compliant Bidder or a single Bidder, without cancellation of all bids or consideration to other Bidders, and to require that Bidder to negotiate with Subcontractors named on their Bid Form.

14. BID ACCEPTANCE PERIOD

.1 Bids will remain open to acceptance by the *Owner* and will be irrevocable until another Bidder enters into a contract with the *Owner* for performance of the Work or until expiry of the bid acceptance period stated in the Bid Form, whichever occurs first.

.2 After bid closing and before expiry of the bid acceptance period stated in the Bid Form, the *Owner* may request all Bidders to agree to an extension of the originally specified bid acceptance period. In such case the bid acceptance period will be extended subject to the Bidder, whose bid the *Owner* wishes to accept, having agreed in writing to the extension.

.3 Where the bidding for procurement of construction services for this project has a method where unofficial bid results are made available publicly after the bid closing time, and before expiry of the bid acceptance period stated in the Bid Form, the *Owner* may request all Bidders to agree to an extension of the originally specified bid acceptance period. In such case, the bid acceptance period will be extended, subject to the lowest compliant Bidder having agreed in writing to the extension.

15. WORKSAFE BC LETTER

.1 After bid closing, upon request, the lowest compliant Bidder agrees to provide a WORKSAFE BC Letter of Good Standing within forty-eight (48) hours.

END OF SECTION

HGH PHARMACY REPLACEMENT PROJECT

LEGEND

PLUMBING

- REFR. LIQUID
- REFR. SUCTION
- DCW
- DHWR
- DHW
- SANITARY
- STORM
- GATE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- STRAINER VALVE
- 2-WAY CONTROL VALVE
- PRESSURE REDUCING VALVE
- PRESSURE RELIEF VALVE
- MECHANICAL PUMP
- PIPE ELBOW DOWN
- PIPE ELBOW/TEE UP
- PIPE TEE DOWN
- PIPE CAP
- PIPE BREAK
- PIPE UNION
- PIPE FLOW DIRECTION ARROW
- PIPE CLEANOUT TO GRADE
- PLUMBING PIPE CLEAN OUT

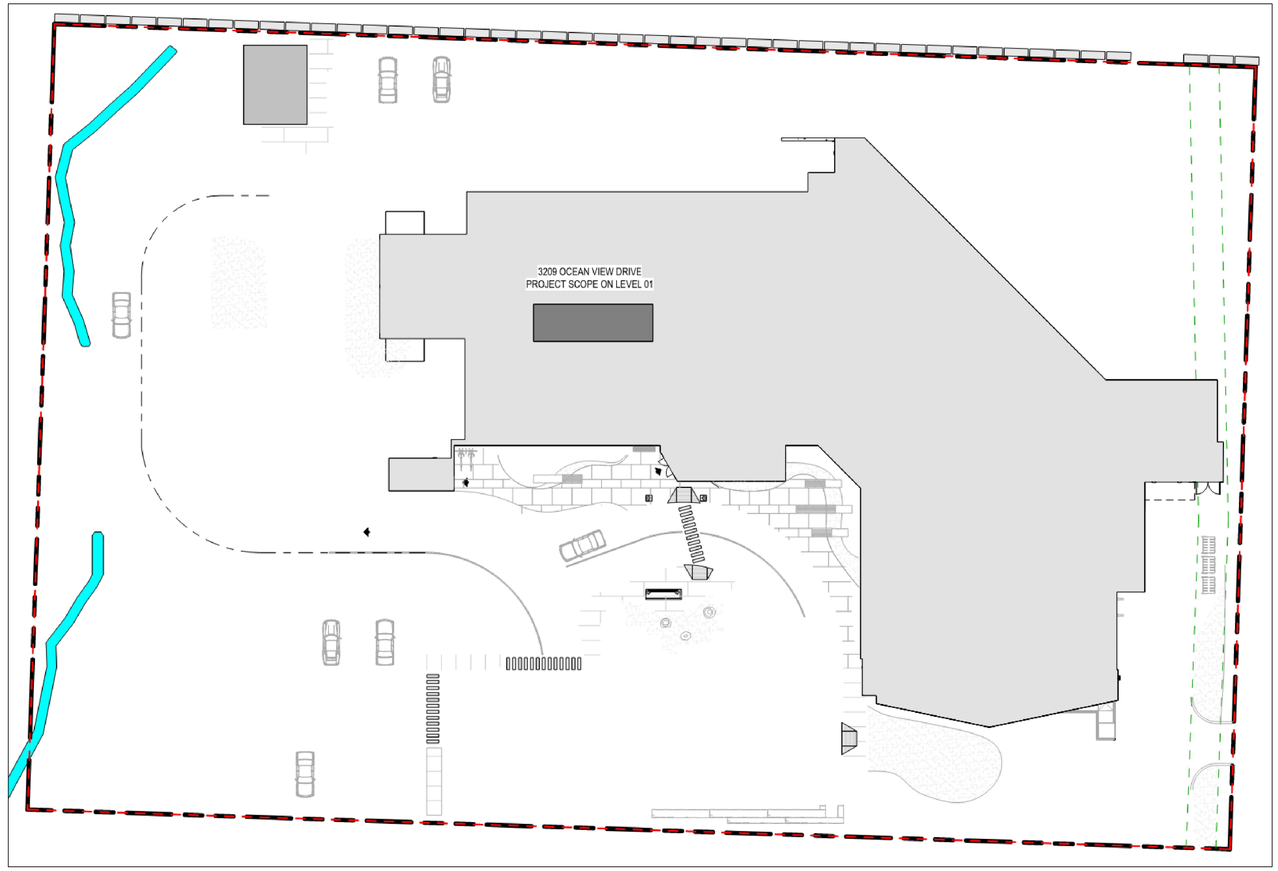
HVAC

DN. UP

- ROUND DUCT
- SUPPLY DUCT
- RETURN DUCT
- EXHAUST DUCT
- ROUND DUCT TEE DOWN
- MITERED DUCT ELBOW W/ VANES
- ANGLED DUCT ELBOW W/ VANES
- DUCT ELBOW 1R
- DUCT ELBOW 1.5R
- DUCT ELBOW 2.5R
- DUCT WITH EXTERNAL INSULATION
- DUCT TRANSITION
- DUCT TAKEOFF
- SUPPLY GRILLE
- RETURN GRILLE
- EXHAUST GRILLE
- COMBINATION FIRE/SMOKE DAMPER
- FIRE DAMPER
- SMOKE DAMPER
- ACOUSTIC LINING AT AIR DUCT

GENERAL NOTES

1. THE MECHANICAL SYSTEM SHALL CONSIST OF ALL THE WORK SHOWN ON DRAWINGS, SCHEMATICS, AND AS DESCRIBED IN SPECIFICATIONS.
2. INSTALL ALL MECHANICAL WORK AS HIGH AS POSSIBLE, TIGHT TO STRUCTURE ABOVE, EXCEPT WHERE CONFLICT OCCURS WITH REQUIREMENTS LISTED UNDER SPECIFICATION (VIBRATION ISOLATION).
3. THE MECHANICAL PLANS ARE DIAGRAMMATIC IN NATURE AND DO NOT ATTEMPT TO SHOW ALL REQUIRED OFFSETS. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS FOR CONSTRUCTION DETAILS.
4. ITEMS NOTED "TYPICAL" OR "TYP" ON ANY SHEET APPLY TO THAT PARTICULAR SHEET.
5. COORDINATE WITH SPECIFICATION. IN CASE OF CONFLICT BETWEEN SPECIFICATIONS AND DRAWINGS THE MORE STRINGENT SHALL APPLY.
6. PROVIDE ELECTRICAL CODE MINIMUM HORIZONTAL AND VERTICAL WORKING CLEARANCE FOR ALL ELECTRICAL PANELS AND EQUIPMENT. OFFSET MECHANICAL AS REQUIRED.
7. COORDINATE ALL MECHANICAL WORK WITH THAT OF OTHER TRADES TO ENSURE PROPER AND ADEQUATE INTERFACE OF THEIR WORK WITH THE WORK OF THIS CONTRACTOR. PROVIDE COORDINATED SHOP DRAWINGS PRIOR TO FABRICATION AND INSTALLATION.
8. MECHANICAL EQUIPMENT SHALL NOT BE USED FOR TEMPORARY HEAT DURING CONSTRUCTION.
9. ALL DUCTWORK SIZES SHOWN ARE INSIDE CLEAR DIMENSIONS. ADD APPROPRIATE DIMENSION FOR INSULATION OR DUCT LINER TO OBTAIN "TOTAL" DUCT SIZE.
10. INSTALL DYNAMIC FIRE DAMPERS AT ALL LOCATIONS WHERE DUCTS PENETRATE FIRE RATED WALLS OR OCCUPANCY SEPARATION WALLS. DAMPER FIRE RATING SHALL BE 1–1/2 HOUR UNLESS NOTED OTHERWISE. COORDINATE DAMPER ACCESS WITH ARCHITECT.
11. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND ELEVATIONS FOR EXACT LOCATION OF ALL DIFFUSERS AND GRILLES.
12. MAXIMUM FLEXIBLE DUCT LENGTH SHALL BE 5'–0" WITH 0.5 X DUCT DIAMETER OFFSET UNLESS NOTED OTHERWISE.
13. PROVIDE TRANSITIONS AS REQUIRED TO CONNECT DUCTWORK TO FANS AND OTHER MECHANICAL EQUIPMENT.
14. PROVIDE DIFFUSER AND GRILLE FRAMES COMPATIBLE WITH ARCHITECTURAL CEILING TYPE. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR CEILING TYPE. COORDINATE DIFFUSER AND GRILLE EXACT LOCATION WITH ARCHITECT PRIOR TO INSTALLATION.
15. COORDINATE EXACT LOCATIONS OF ALL ROOM THERMOSTATS AND/OR ROOM TEMPERATURE SENSORS WITH ARCHITECT PRIOR TO INSTALLATION.
16. PROVIDE VOLUME DAMPER FOR EACH SUPPLY, RETURN AND EXHAUST OPENING. PROVIDE BALANCING DAMPER IN BRANCHES WHERE THREE OR MORE OPENINGS ARE ASSOCIATED WITH THE BRANCH AND ELSEWHERE AS NOTED ON THE DRAWINGS AND SPECIFICATIONS.
17. COORDINATE EXACT LOCATION AND MOUNTING HEIGHTS OF ALL PLUMBING FIXTURES WITH CASEWORK AND ARCHITECTURAL DRAWINGS.
18. INSULATE DUCT PLENUMS FOR OUTSIDE AIR, RETURN AIR AND EXHAUST AIR. FOR ALL OTHER DUCTWORK INSULATION REFER TO SPECIFICATIONS.
19. REFER TO MECHANICAL DETAILS FOR ADDITIONAL ACOUSTICAL AND THERMAL INSULATION REQUIREMENTS FOR DUCT AND EQUIPMENT.
20. SEISMIC RESTRAINTS FOR ALL EQUIPMENT AND PIPING SHALL BE COVERED BY MECHANICAL CONTRACTOR.
21. SEISMIC ENGINEER SHALL BE RETAINED UNDER THE MECHANICAL CONTRACTOR'S SCOPE OF WORK TO ENSURE SEISMIC INSTALLATIONS ARE INSTALLED IN ACCORDANCE WITH CODE. SEISMIC INSTALLATION SHALL BE APPROVED BY A CERTIFIED SEISMIC ENGINEER AND PROVIDE SIGNED SEALED SHOP DRAWINGS TO THAT EFFECT.
22. UNLESS NOTED OTHERWISE, ALL SANITARY AND STORM DRAINS OF SIZES 3 INCHES (75 MM) AND SMALL SHALL BE SLOPED TO 2%, AND DRAINS OF SIZES 4 INCHES (100MM) AND LARGER TO BE SLOPED AT 1%.
23. ALL WIRING ABOVE T–BAR SHALL BE INSTALLED WITHIN CONDUIT. INSTALLATION SHALL BE ORDERLY AND FOLLOW BUILDING LINES.



1 / M0.0 SITE PLAN
N.T.S.

DRAWING LIST

HYDRAULIC LOAD SUMMARY

PROJECT HYDRAULIC LOAD (COLD) = 4.5 FU (AT 1.5M/S)

PROJECT HYDRAULIC LOAD (HOT) = 4.5 FU (AT 1.2M/S)

CIVIC ADDRESS

3209 OCEANVIEW DRIVE, DAAJING GIIDS, BC

SANITARY LOAD SUMMARY

PROJECT SANITARY LOAD = 4 FU

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VANCOUVER, BC V6A 1Z6

ARCHITECT:

KRA
KIRSTEN REITE ARCHITECTURE

KEYPLAN:

No.	DATE	DESCRIPTION	BY
4	2025.03.03	ISSUED FOR TENDER	SA
3	2024.11.08	ISSUED FOR 100% CD	SA
2	2024.09.06	ISSUED FOR 90% CD	SA
1	2024.08.19	ISSUED FOR 70% CD	SA

REVISIONS:

SEAL:

CLIENT:

northern health
the northern way of caring

PROJECT:

HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:

COVER SHEET & SITE PLAN

PROJECT NUMBER:

24348-V

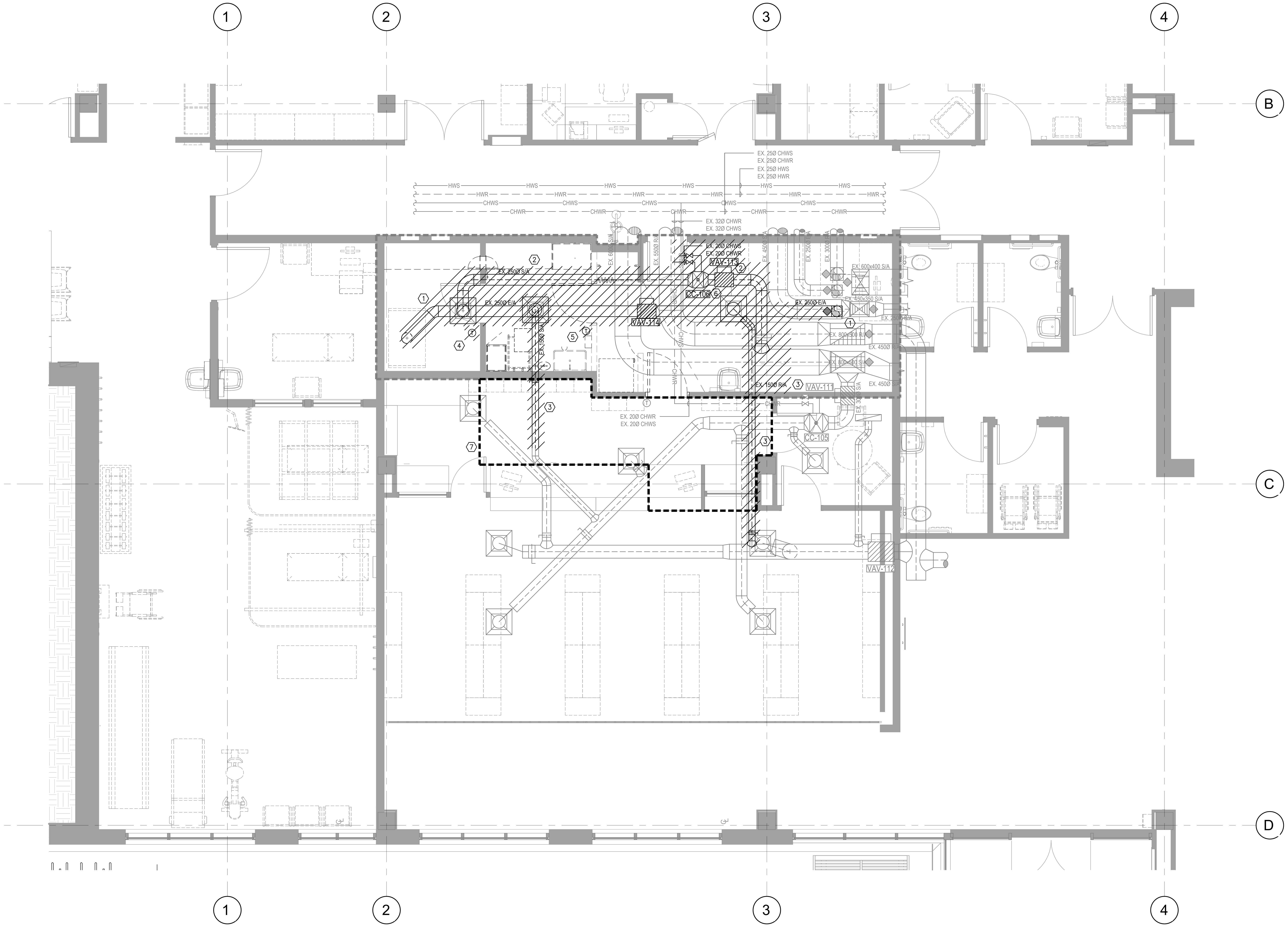
DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:

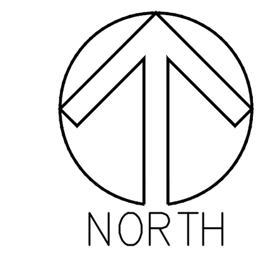
M0.0

- OF -

2/28/2025 8:55 AM



1
M1.1
HVAC LEVEL 1 DEMOLITION PLAN
1:50



GENERAL NOTES

1. PERFORM PRE-DEMOLITION AIR BALANCING ASSESSMENT TO CONFIRM EXISTING SUPPLY, RETURN AND EXHAUST AIR SYSTEM FLOW RATES FOR ALL INLETS AND OUTLETS WITHIN PROJECT AREA. REPORT FINDINGS TO MECHANICAL CONSULTANT.
2. COORDINATE ALL SHUTDOWNS WITH FACILITY MANAGEMENT TEAM.
3. DEMOLISH ALL EXISTING TERMINAL UNITS, DUCTWORK AND DIFFUSERS WHERE INDICATED.
4. DEMOLISH EXISTING WALL-MOUNTED COOLING COIL CONTROLLER .
5. RELOCATE EXISTING WALL-MOUNTED RADIANT PANEL CONTROLLER TO SUIT NEW LAYOUT.
6. ALLOWANCE FOR NIGHT WORK AT PHARMACY COUNTER.

DRAWING KEY NOTES

1. DEMOLISH EXISTING BSC EXHAUST AIR VALVE VAV-114 AND ASSOCIATED SS WELDED 250Ø EXHAUST DUCTWORK BETWEEN CABINET AND TRANSITION TO RISER SHAFT
2. DEMOLISH EXISTING SUPPLY AIR VALVE VAV-113 AND ASSOCIATED DUCTWORK AND DIFFUSER
3. DEMOLISH RETURN DUCTWORK AND DIFFUSERS
4. DEMOLISH WALL-MOUNTED COOLING COIL CC-106 CONTROLLER
5. DEMOLISH EXISTING THERMOSTAT TO CC-105
6. DEMOLISH EXISTING COOLING COIL CC-106, DRAIN PAN, CONTROL VALVE, AND CHWS/R PIPING, ISOLATE AT EXISTING VALVES AND CAP-OFF
7. ALLOWANCE FOR NIGHT WORK AT PHARMACY COUNTER.

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ARCHITECT:

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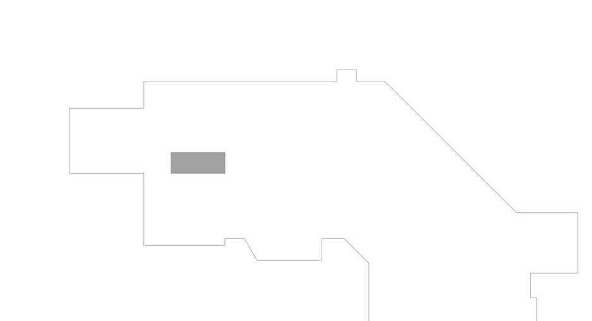
KIRSTEN REITE ARCHITECTURE

KEYPLAN:



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1	2024.08.19	ISSUED FOR 70% CD	SA

REVISIONS:

SEAL:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
S. ADAMSON
49002

2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:
HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:
HVAC LEVEL 1 DEMOLITION PLAN

PROJECT NUMBER:
24348-V

DRAWN BY: MK
DESIGNED BY: MK
APPROVED BY: SA
SCALE: REFER TO VIEWS

DRAWING:
M1.1

- OF -

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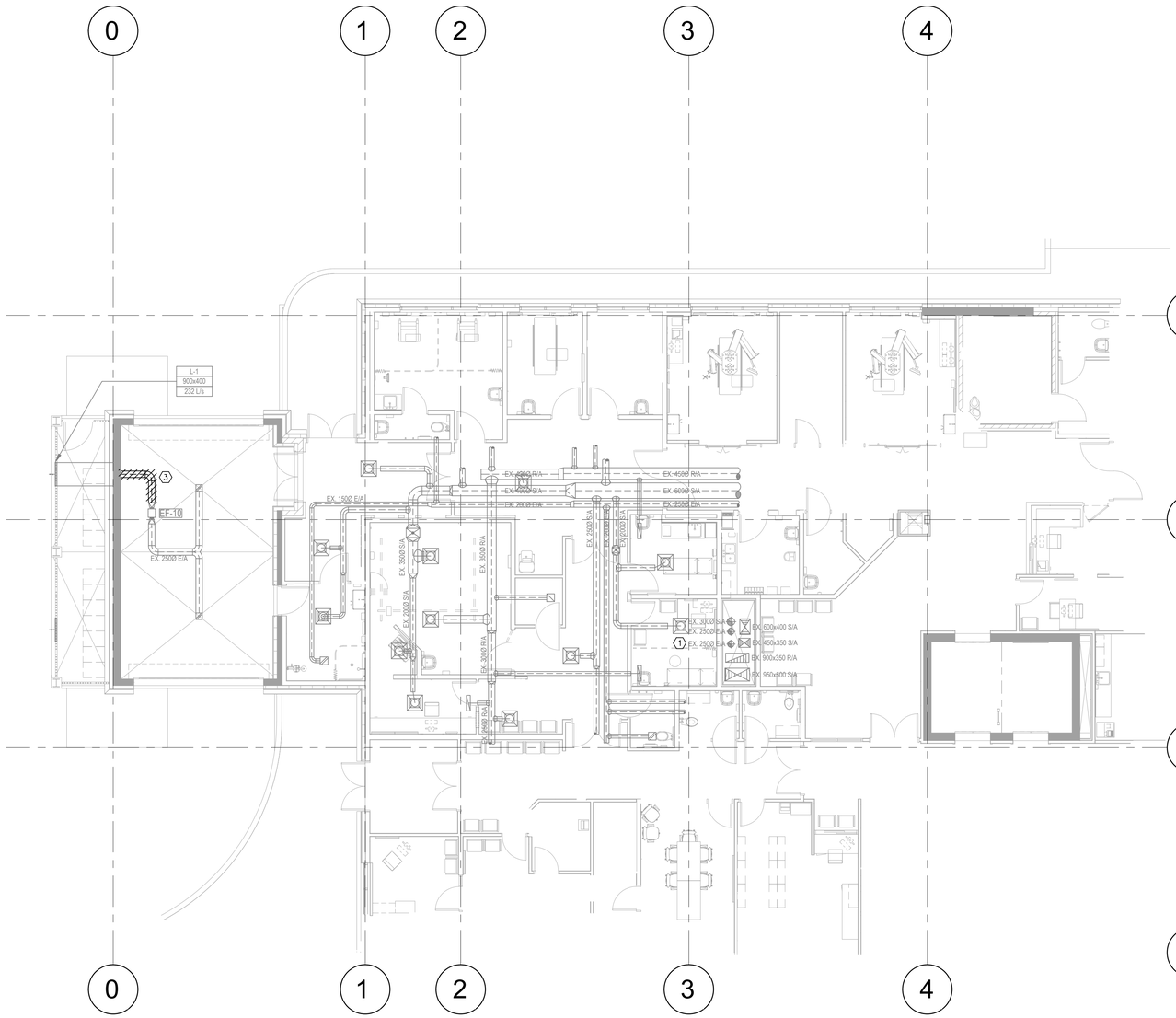


1 / M1.2 HVAC LEVEL 2 DEMOLITION PLAN
1:100

GENERAL NOTES

1. COORDINATE ALL SHUTDOWNS WITH FACILITY MANAGEMENT TEAM.

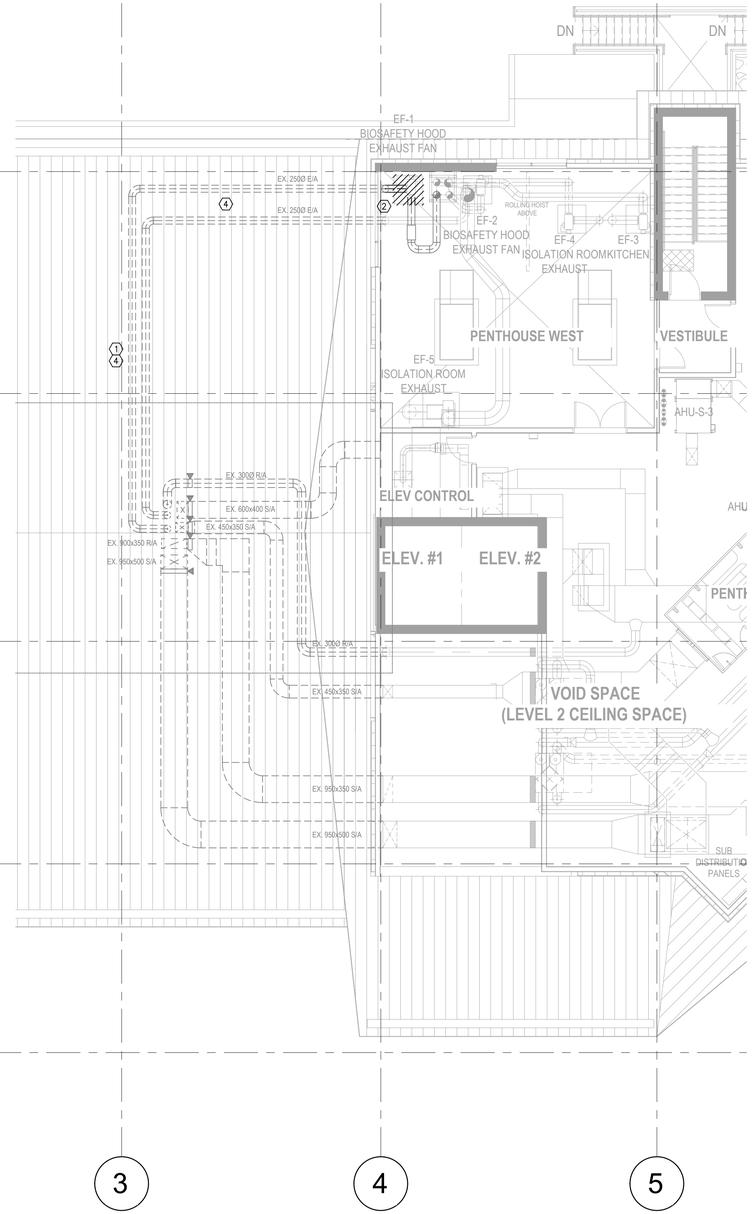
DRAWING KEY NOTES

(1) RETAIN EXISTING WELDED STAINLESS STEEL EXHAUST AIR DUCTWORK AT DUCT SHAFT, LEVEL 2 CEILING SPACE AND PENTHOUSE SERVING THE BSC CABINET

(2) DEMOLISH EXISTING EXHAUST FAN EF-2 SERVING BSC, RETAIN DUCT SILENCER AND DUCT DISTRIBUTION WITHIN PENTHOUSE

(3) DEMOLISH 250Ø EXHAUST AIR DUCT BETWEEN FAN AND LOUVER PLENUM AT AMBULANCE GARAGE

(4) EXISTING FIRE RATED DUCT WRAP



2 / M1.2 HVAC PENTHOUSE DEMOLITION PLAN
1:100

2/28/2025 9:58 AM

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KEYPLAN:

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4	2025.03.03	ISSUED FOR TENDER	SA
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2	2024.09.06	ISSUED FOR 90% CD	SA
1	2024.08.19	ISSUED FOR 70% CD	SA

REVISIONS:

SEAL:

2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:

HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:

HVAC PENTHOUSE DEMOLITION PLAN

PROJECT NUMBER:

24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:

M1.2

- OF -

1 / M1.3 PLUMBING LEVEL 1 DEMOLITION PLAN
1:50

DRAWING KEY NOTES

1. DEMOLISH EXISTING HAND HYGIENE SINK, DCW, DHW, DWHR, AND VENT. RETAIN EXISTING SAN IN-WALL FOR CONNECTION TO NEW SINK
2. REMOVE AND RETAIN EXISTING SCRUB SINK AND EYE WASH FOR RE-INSTALLATION. RETAIN ALL ACCESSORIES, INCLUDING THERMOSTATIC MIXING VALVES, FOR RE-INSTALLATION. DEMOLISH ASSOCIATED DCW, DHW, DHWR, SAN AND VENT LINES IN-WALL UP TO CEILING.
3. DEMOLISH AND CAP OFF CONDENSATE PIPE

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REVISIONS:

SEAL:

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2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:
HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:
PLUMBING LEVEL 1 DEMOLITION PLAN

PROJECT NUMBER:
24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:
M1.3

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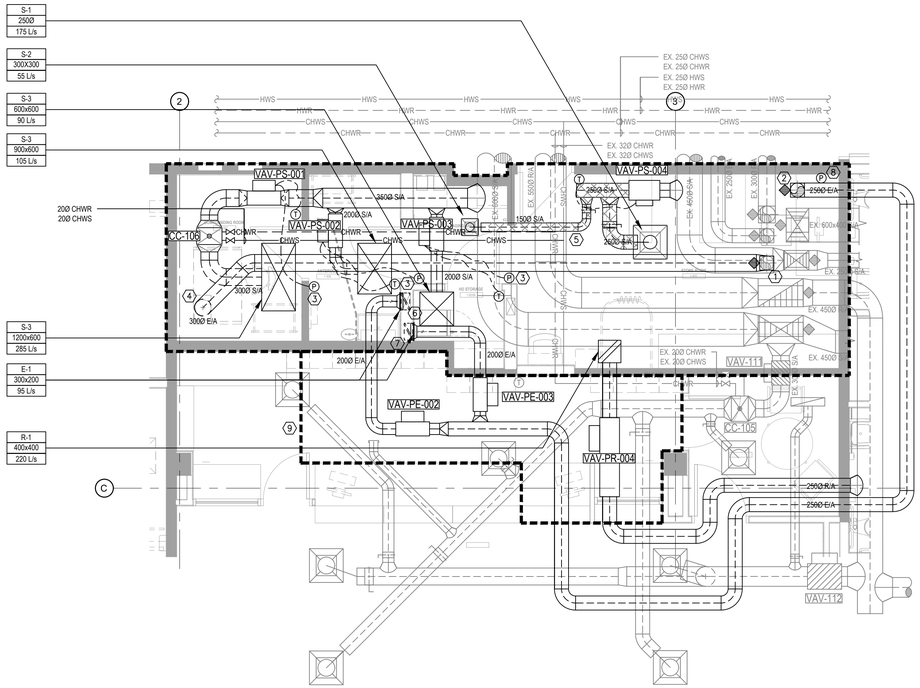

1 M2.1 HVAC LEVEL 1 NEW PLAN
1:50

2/28/2025 9:37 AM

GENERAL NOTES

1. COORDINATE ALL STARTUPS WITH FACILITY MANAGEMENT TEAM.
2. ENSURE ACCESS TO ALL DAMPERS AND VALVES. PROVIDE WALL OR CEILING ACCESS PANELS WHERE NECESSARY.
3. PROVIDE AIR BALANCING FOR ALL INLETS AND OUTLETS. PROVIDE BALANCING DAMPERS FOR ALL INLETS AND OUTLETS
4. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND ELECTRICAL LIGHTING LAYOUT, COORDINATE DIFFUSER AND GRILLE LOCATIONS WITH RCPs.
5. REFER TO ARCHITECT'S RCP AND PROVIDE ACCESS PANELS AT GYPSUM BOARD CEILING FOR DAMPERS & VALVES.
6. CONNECT TERMINAL UNITS, CONTROLLERS AND SENSORS TO BASE BUILDING MANAGEMENT SYSTEM.
7. ALLOWANCE FOR NIGHT WORK AT PHARMACY COUNTER.

DRAWING KEY NOTES

1. PROVIDE TRANSITION AND CONNECT NEW 300Ø SS WELDED BSC EXHAUST DUCT TO EXISTING 250Ø SS DUCT
2. 250Ø E/A FOR ANTEROOM AND HD STORAGE RISES UP TO ROOF
3. ROOM PRESSURE MONITOR WITH AUDIO AND VISUAL ALARM. REFER TO M4.2.
4. WELDED STAINLESS STEEL EXHAUST AIR DUCT FOR BSC CABINET SYSTEM
5. NEW 20Ø CHWS&R PIPE CONNECT TO EXISTING 32Ø CHWS&R PIPES
6. 500x150 E/A TURNS TO LOW LEVEL C/W WALL MOUNTED AIR GRILLE
7. 500x150 E/A TURNS TO LOW LEVEL C/W WALL MOUNTED AIR GRILLE (ELEVATION TO SUIT NEW REFRIGERATOR)
8. MULTI-VARIABLE MONITOR WITH TOUCHSCREEN INTERFACE FOR ROOM MONITORING
9. ALLOWANCE FOR NIGHT WORK AT PHARMACY COUNTER

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ARCHITECT:

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REVISIONS:

SEAL:

2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:

HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:

HVAC LEVEL 1 NEW PLAN

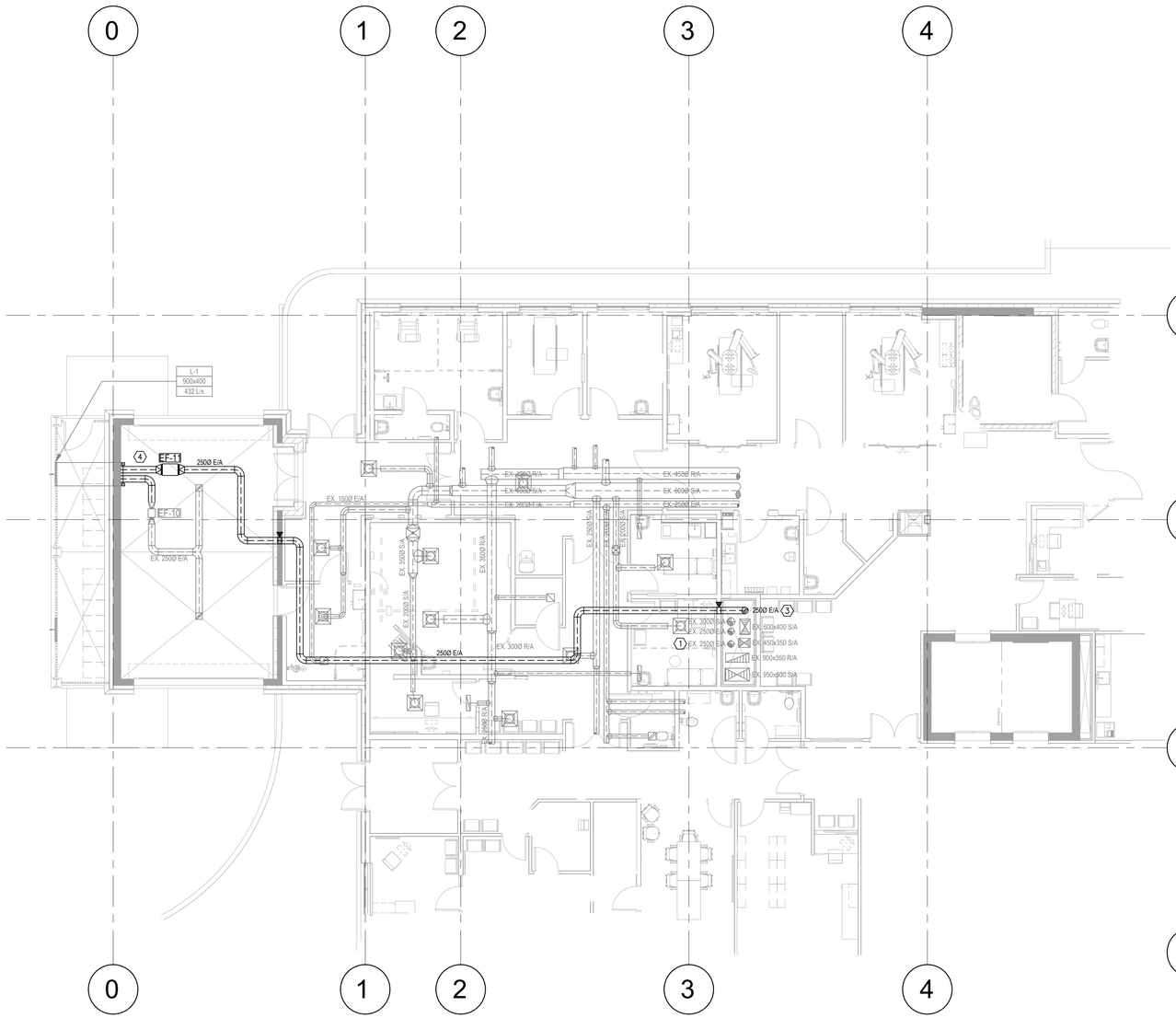
PROJECT NUMBER:
24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:

M2.1

- OF -



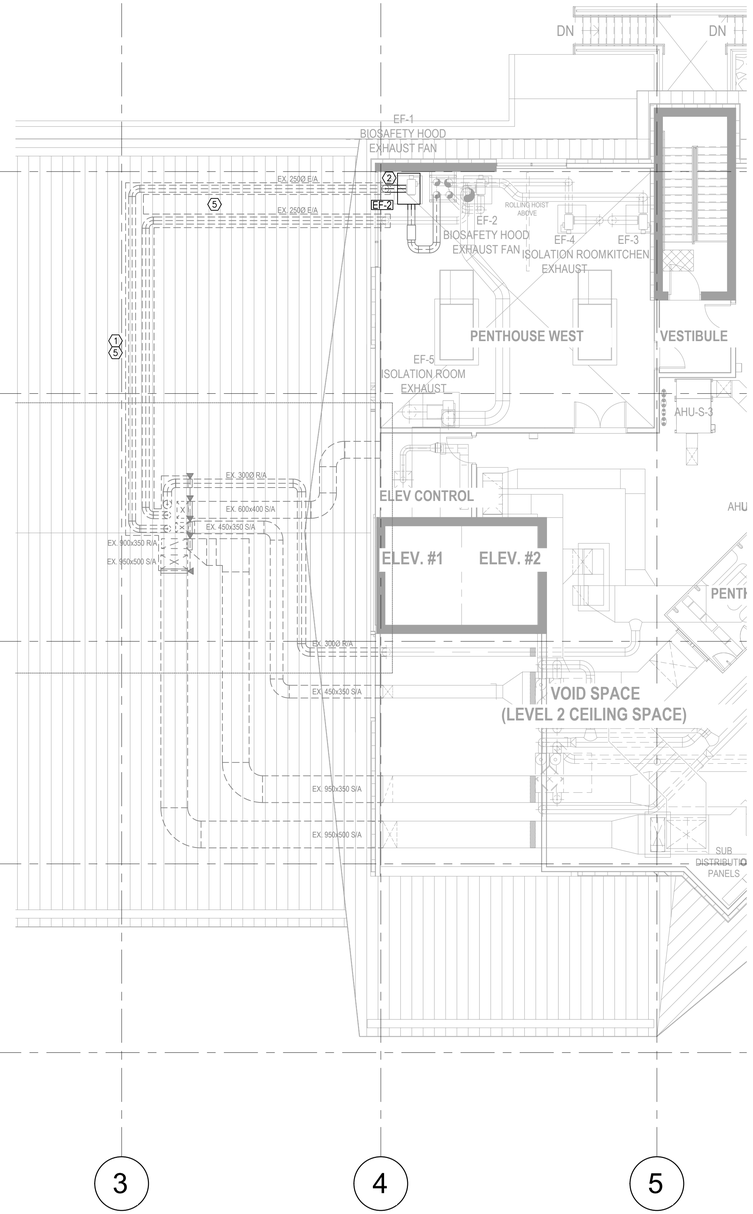
1 M2.2 HVAC LEVEL 2 NEW PLAN
1:100

GENERAL NOTES

1. COORDINATE ALL STARTUPS WITH FACILITY MANAGEMENT TEAM.
2. RETAIN DUCTWORK WITHIN DUCT SHAFT.
3. ENSURE ACCESS TO ALL DAMPERS AND VALVES, PROVIDE WALL OR CEILING ACCESS PANELS WHERE NECESSARY.
4. CONNECT EXHAUST AIR FANS TO BASE BUILDING MANAGEMENT SYSTEM.

DRAWING KEY NOTES

1. RETAIN EXISTING WELDED STAINLESS STEEL EXHAUST AIR DUCTWORK AT DUCT SHAFT, LEVEL 2 CEILING SPACE AND PENTHOUSE SERVING THE BSC CABINET
2. NEW EXHAUST AIR FAN INSTALL ON ISOLATION BASE WITH VIBRATION ISOLATORS. PROVIDE TRANSITIONS NEEDED TO SUIT CONNECTION TO EXISTING WELDED STAINLESS STEEL DUCTWORK AT INLET AND DISCHARGE.
3. 2500 PHARMACY EXHAUST AIR DUCT RISES UP FROM LEVEL 1 TO LEVEL 2 HIGH LEVEL
4. NEW EXHAUST AIR FAN EF-11 AT HIGH LEVEL, INTERLOCK WITH MOTORIZED DAMPER. PROVIDE NEW REVISED 2500 E/A DUCT SERVING EXISTING EF-10 TO EXISTING LOUVRE TO SUIT ADDED EXHAUST CONNECTION TO LOUVRE.
5. RETAIN EXISTING FIRE RATED DUCT WRAP



2 M2.2 HVAC PENTHOUSE NEW PLAN
1:100

2/28/2025 9:36 AM

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ARCHITECT:

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KEYPLAN:

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4	2025.03.03	ISSUED FOR TENDER	SA
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REVISIONS:

SEAL:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:
HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:
HVAC PENTHOUSE NEW PLAN

PROJECT NUMBER:
24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:
M2.2

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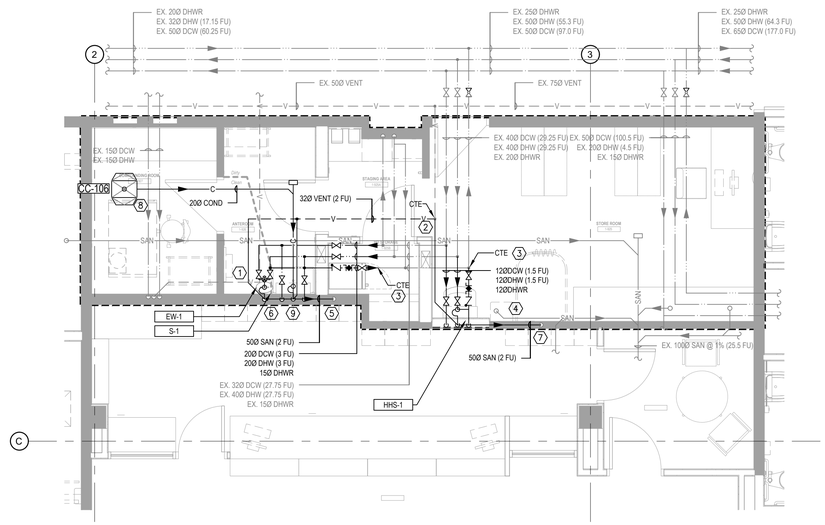

1 M2.3 PLUMBING LEVEL 1 NEW PLAN
1:50

2/28/2025 8:58 AM

GENERAL NOTES

1. THE MECHANICAL PLANS ARE DIAGRAMMATIC IN NATURE AND DO NOT ATTEMPT TO SHOW ALL REQUIRED ELBOWS AND OFFSETS. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS FOR CONSTRUCTION DETAILS.
2. COORDINATE WITH SPECIFICATION. IN CASE OF CONFLICT BETWEEN SPECIFICATIONS AND DRAWINGS, THE MORE STRINGENT SHALL APPLY.
3. UNLESS OTHERWISE NOTED, ALL SANITARY DRAINS OF SIZES 75MMØ AND SMALLER SHALL BE SLOPED AT 2%, AND DRAIN OF 100MMØ AND LARGER SHALL BE SLOPED AT 1%.
7. CONNECT 12MMØ DHWR TO DHW WITHIN 6 FEET OF FIXTURE TO LIMIT LENGTH OF DEAD LEG, PROVIDE CHECK VALVES AND BALANCING VALVES FOR ALL DHWR CONNECTIONS TO MAINS.
8. REFER TO PLUMBING FIXTURE SCHEDULE AND DETAILS SHEET FOR SPECIFIC CONNECTION SIZES AND ARRANGEMENTS.
9. DO NOT INSTALL PLUMBING LINES WITHIN OR ABOVE ELECTRICAL OR LOW VOLTAGE ROOMS.
10. REFER TO DETAILS AND SPECIFICATIONS FOR SPECIFIC PIPING AND ACCESSORIES.

DRAWING KEY NOTES

1. LOCATE EXISTING THERMOSTATIC MIXING VALVE FOR EYE WASH IN AN ACCESSIBLE LOCATION ABOVE CEILING AND PROVIDE ACCESS PANEL IF REQUIRED.
2. NEW 32Ø VENT PIPE CONNECTS TO EXISTING VENT LINE
3. NEW DCW, DHW AND DHWR PIPES CONNECT TO EXISTING BASE BUILDING PLUMBING LINES
4. EXISTING DCW, DHW, DHWR AND VENT PIPES CONNECT TO NEW HAND HYGIENE SINK
5. OFFSET NEW EYE WASH AND SINK DRAINS IN-WALL TO CONNECT TO EXISTING SAN ABOVE GRADE
6. INSTALL EXISTING EYEWASH AND SCRUB SINK AT NEW LOCATIONS INCLUDING ALL RETAINED ACCESSORIES
7. OFFSET NEW SINK DRAINS IN-WALL TO CONNECT TO EXISTING SAN ABOVE GRADE
8. 20Ø CONDENSATE DRAINAGE PIPING C/W TRAP FROM COOLING COIL AT 2% SLOPE
9. CONDENSATE DRAINAGE PIPE CONNECTS TO NEAREST SANITARY

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ARCHITECT:

KRA
KIRSTEN REITE ARCHITECTURE

KEYPLAN:

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2	2024.09.06	ISSUED FOR 90% CD	SA
1	2024.08.19	ISSUED FOR 70% CD	SA

REVISIONS:

SEAL:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
50902

2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:
HGH PARMACY UPGRADE

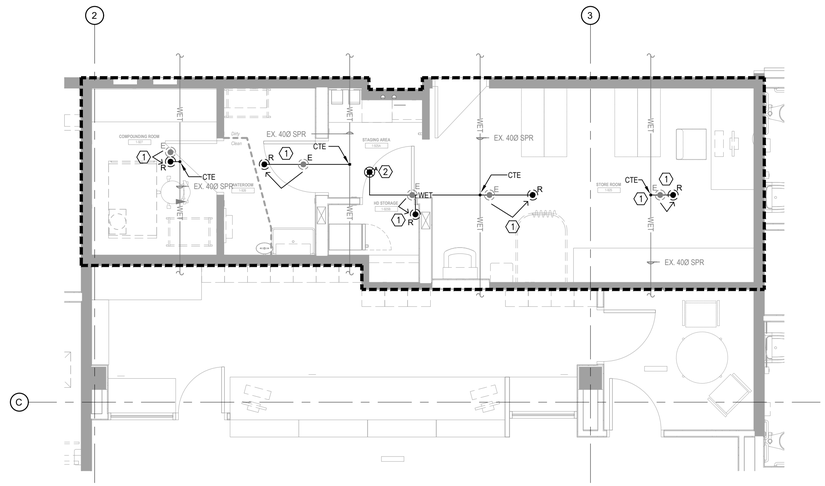
3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:
PLUMBING LEVEL 1 NEW PLAN

PROJECT NUMBER:
24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:
M2.3



1 / M2.4 FIRE PROTECTION LEVEL 1 NEW PLAN
1:50

2/28/2025 8:37 AM

GENERAL NOTES

1. COORDINATE ALL FIRE PROTECTION WORK WITH THAT OF OTHER TRADES TO ENSURE PROPER AND ADEQUATE INTERFACE OF THEIR WORK WITH THE WORK OF THIS CONTRACTOR. PROVIDE COORDINATED SHOP DRAWINGS PRIOR TO FABRICATION AND INSTALLATION.
2. ANY SERVICES NOT SHOWN ON THE DRAWINGS THAT ARE EXPOSED DURING CONSTRUCTION SHALL BE VERIFIED BY THE CONTRACTOR AS TO THE SOURCE AND ROUTING. REPORT TO THE CONSULTANT WITH PROPOSED RESOLUTIONS FOR THE SERVICES THAT HAVE BEEN EXPOSED AT NO EXTRA COST TO CLIENT.
3. REVIEW AND COORDINATE LAYOUT WITH CONSULTANTS PRIOR TO INSTALLATION.
4. RELOCATE AND ADD SPRINKLER HEADS AND ASSOCIATED PIPEWORK & ACCESSORIES AS INDICATED. NOTE THAT CEILING TYPE IS CHANGED FROM EXISTING. EXISTING HEADS ARE RECESSED PENDENT STANDARD COVERAGE.

DRAWING KEY NOTES

1. RELOCATE EXISTING RECESSED PENDENT SPRINKLER HEAD AND FLEXIBLE SPRINKLER PIPE FROM EXISTING SPRINKLER PIPE
2. INSTALL NEW RECESSED PENDENT SPRINKLER HEAD AND FLEXIBLE SPRINKLER PIPE FROM EXISTING SPRINKLER PIPE

SPRINKLER HEAD SCHEDULE

SYMBOL	MAKE	MODEL	TYPE	COVERAGE	RESPONSE	"K"	TEMP (°C)	QUANTITY	FINISH
	-	-	CONCEALED PENDANT	STANDARD	QUICK	5.60	68.30	REFER TO SHEET	WHITE
	TYCO RFII	TY3531	CONCEALED PENDANT	4.5m x 4.5m	QUICK	5.60	68.30	REFER TO SHEET	WHITE

QUANTITIES SHALL BE +/- AS REQUIRED BY CONTRACTOR TO SUIT SCOPE OF WORK

"E" INDICATES EXISTING
"R" INDICATES THAT EXISTING SPRINKLER IS RELOCATED

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ARCHITECT:

KRA
KIRSTEN REITE ARCHITECTURE

KEYPLAN:

No.	DATE	DESCRIPTION	BY
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4	2025.03.03.	ISSUED FOR TENDER	SA
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1	2024.08.19	ISSUED FOR 70% CD	SA

REVISIONS:

SEAL:

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2025-02-28
Permit to Practice # 1000700

CLIENT:

northern health
the northern way of caring

PROJECT:

HGH PARMACY UPGRADE

3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:

FIRE PROTECTION LEVEL 1
NEW PLAN

PROJECT NUMBER:

24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

DRAWING:

M2.4

- OF -

PLUMBING FIXTURE SCHEDULE

TAG No.	TYPE	MANUFACTURER	MODEL	FIXTURE CONNECTIONS (mm)				DESCRIPTION
				DCW	DHW	DRAIN	VENT	
HHS–1	HAND HYGIENE	AMERICAN STANDARD	9118 111	12	12	40	32	9118 111 ICU SINK, Z8000 COMPLIANT ANTIMICROBIAL HAND HYGIENE SINK WITH REMOVABLE ACRYLIC SHROUD, WHITE VITREOUS CHINA, OFFSET DRAIN, STRAINER, P–TRAP WITH TAIL PIECE, 1 FAUCET HOLE, NO OVERFLOW, WALL MOUNTED WITH CARRIER; CHICAGO ELECTRONIC SENSOR FAUCET 116.779.AB.1T, DECK MOUNTED, SINGLE HOLE, TOUCH–FREE PROGRAMMABLE FAUCET WITH ABOVE–DECK ELECTRONICS, FIELD ADJUSTABLE TEMPERATURE CONTROL MIXER, HARD WIRED 12V TRANSFORMER, LAMINAR FLOW SPOUT, 5.7 L/MIN; TRIM: FLEXIBLE S.S. SUPPLIES AND SHUT OFF VALVES, P–TRAP, ESCUTCHEONS, BRADLEY S59–4000BY MIXING VALVE
S–1	SCRUB SINK	–	–	12	12	40	32	EXISTING SCRUB SINK
EW–1	EYE WASH	–	–	12	12	32	32	EXISTING EYE WASH

VAV SCHEDULE

TAG No.	SERVICE	MANUFACTURER	MODEL	SIZE	MIN FLOW (L/S)	MAX FLOW (L/S)	NOTES AND ACCESSORIES
VAV–PS–001	COMPOUNDING ROOM	ANTEC	VV	108	285	285	ACTUATOR BY CONTROLS CONTRACTOR
VAV–PS–002	ANTEROOM	ANTEC	VV	108	105	105	ACTUATOR BY CONTROLS CONTRACTOR
VAV–PS–003	HD STORAGE	ANTEC	VV	108	90	90	ACTUATOR BY CONTROLS CONTRACTOR
VAV–PS–004	STAGING AREA & STORE	EH PRICE	SDV	7	115	225	ACTUATOR BY CONTROLS CONTRACTOR
VAV–PE–002	ANTEROOM	ANTEC	VV	108	95	95	ACTUATOR BY CONTROLS CONTRACTOR
VAV–PE–003	HD STORAGE	ANTEC	VV	108	95	95	ACTUATOR BY CONTROLS CONTRACTOR
VAV–PR–004	STAGING AREA & STORE	EH PRICE	SDE	7	115	220	INTEGRAL 900MM ATTENUATOR WITH FIBRE FREE LINER ACTUATOR BY CONTROLS CONTRACTOR

EXHAUST FANS

TAG No.	SERVICE	MANUFACTURER	MODEL	LOCATION	AIRFLOW (L/S)	STATIC PRESSURE (PA)	RPM	WEIGHT (KG)	ELECTRICAL		NOTES AND ACCESSORIES
									KW	V/Ph/Hz	
EF–2	BSC CABINET AT COMPOUNDING ROOM	GREENHECK	IP–9	PENTHOUSE WEST	315	1500	2100	145	1.15	208/3/60	FLOOR MOUNTED UTILITY EXHAUST FAN, DIRECT DRIVE EC MOTOR WITH EXTERNAL SPEED CONTROL, ISOLATION BASE OF A MINIMUM OF 25MM STATIC DEFLECTION
EF–11	ANTEROOM & HD STORAGE	COOK	120SQN28D081VF	AMBULANCE GARAGE	200	750	2700	45	0.75	120/1/60	CEILING MOUNTED INLINE EXHAUST FAN, DIRECT DRIVE EC MOTOR WITH EXTERNAL SPEED CONTROL, CEILING MOUNTED SPRING ISOLATOR OF A MINIMUM OF 25MM STATIC DEFLECTION

GRILLES AND DIFFUSERS

TAG No.	DESCRIPTION	MANUFACTURER	MODEL	SIZE	FINISH	NOTES AND ACCESSORIES
S–1	SQUARE PLAQUE	EH PRICE	SPD	SEE DWGS	WHITE	600X600, REFER TO DWG FOR NECK SIZE, PROVIDE T–BAR LAY IN OR DRYWALL MOUNT WHERE NEEDED COLOR SHALL BE SELECTED BY ARCHITECT AND CONFIRMED PRIOR TO ORDERING. GRILLES AND DIFFUSERS SHALL BE PROVIDED TO CONFORM THE ARCHITECTURAL AND STRUCTURAL DETAILING.
S–2	SQUARE PLAQUE	EH PRICE	SPD	SEE DWGS	WHITE	300X300, REFER TO DWG FOR NECK SIZE, PROVIDE T–BAR LAY IN OR DRYWALL MOUNT WHERE NEEDED COLOR SHALL BE SELECTED BY ARCHITECT AND CONFIRMED PRIOR TO ORDERING. GRILLES AND DIFFUSERS SHALL BE PROVIDED TO CONFORM THE ARCHITECTURAL AND STRUCTURAL DETAILING.
S–3	LAMINAR FLOW DIFFUSER	EH PRICE	LFDC	SEE DWGS	WHITE	ALUMINUM DIFFUSER, C/W HEPA FILTER, ROOM–SIDE ADJUSTABLE DAMPER, FACTORY INSTALLED INSULATION COLOR SHALL BE SELECTED BY ARCHITECT AND CONFIRMED PRIOR TO ORDERING. GRILLES AND DIFFUSERS SHALL BE PROVIDED TO CONFORM THE ARCHITECTURAL AND STRUCTURAL DETAILING.
R–1	FIXED BLADE RETURN GRILLE	EH PRICE	530D	SEE DWGS	WHITE	STEEL LOUVERED GRILLE, OPPOSED BLADE DAMPER COLOR SHALL BE SELECTED BY ARCHITECT AND CONFIRMED PRIOR TO ORDERING. GRILLES AND DIFFUSERS SHALL BE PROVIDED TO CONFORM THE ARCHITECTURAL AND STRUCTURAL DETAILING.
E–1	FIXED BLADE RETURN GRILLE	EH PRICE	530D	SEE DWGS	WHITE	STEEL LOUVERED GRILLE, OPPOSED BLADE DAMPER COLOR SHALL BE SELECTED BY ARCHITECT AND CONFIRMED PRIOR TO ORDERING. GRILLES AND DIFFUSERS SHALL BE PROVIDED TO CONFORM THE ARCHITECTURAL AND STRUCTURAL DETAILING.

COOLING COIL

TAG No.	SERVICE	LOCATION	AIR VOLUME (L/S)	AIR PRESSURE DROP (PA)	ON COIL		OFF COIL		DUTY		FACE VELOCITY (M/S)	WATER				NOTES AND ACCESSORIES
					DB TEMP (°C)	WB TEMP (°C)	DB TEMP (°C)	WB TEMP (°C)	SENSIBLE (KW)	TOTAL (KW)		EWT (°C)	LWT (°C)	FLOW (L/S)	PRESSURE DROP (kPa)	
CC–106	COMPOUNDING ROOM	COMPOUNDING ROOM	285	75	18	14.6	14	12.3	1.39	2.07	2.5	10.0	16.0	0.082	35	STAINLESS STEEL DRAIN PAN, REFER TO DETAILS

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ARCHITECT:
KRA
KIRSTEN REITE ARCHITECTURE

KEYPLAN:

No.	DATE	DESCRIPTION	BY
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REVISIONS:

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2025-02-28
Permit to Practice # 1000700

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northern health
the northern way of caring

PROJECT:
HGH PARMACY UPGRADE

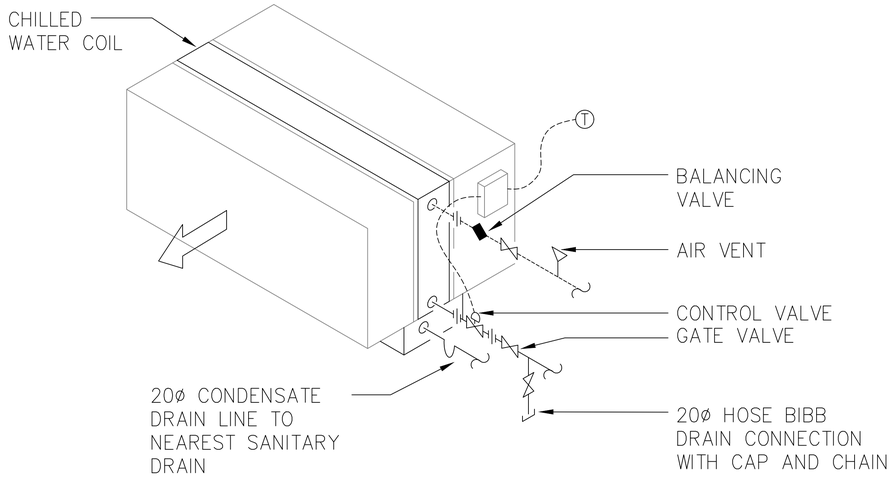
3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:
EQUIPMENT SCHEDULES

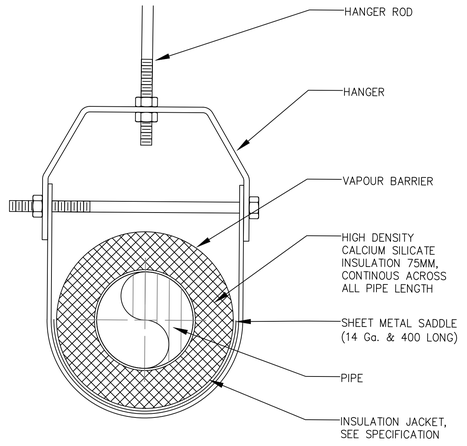
PROJECT NUMBER:
24348-V

DRAWN BY:	MK
DESIGNED BY:	MK
APPROVED BY:	SA
SCALE:	REFER TO VIEWS

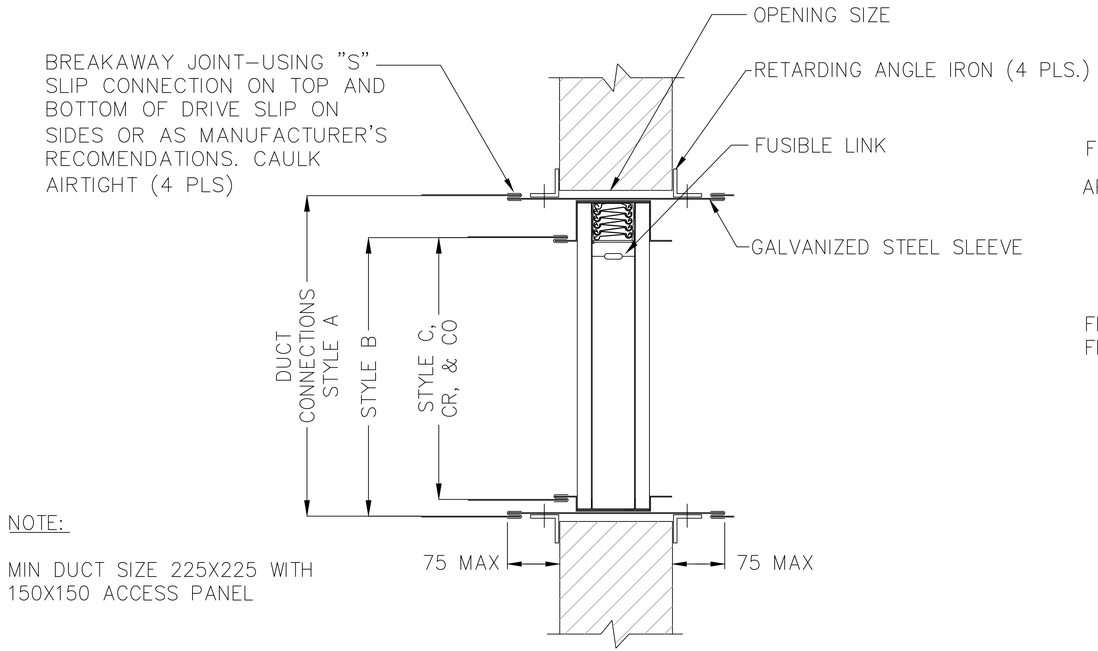
DRAWING:
M3.0



1 / M4.0 COOLING COIL DETAIL
Scale: N.T.S.



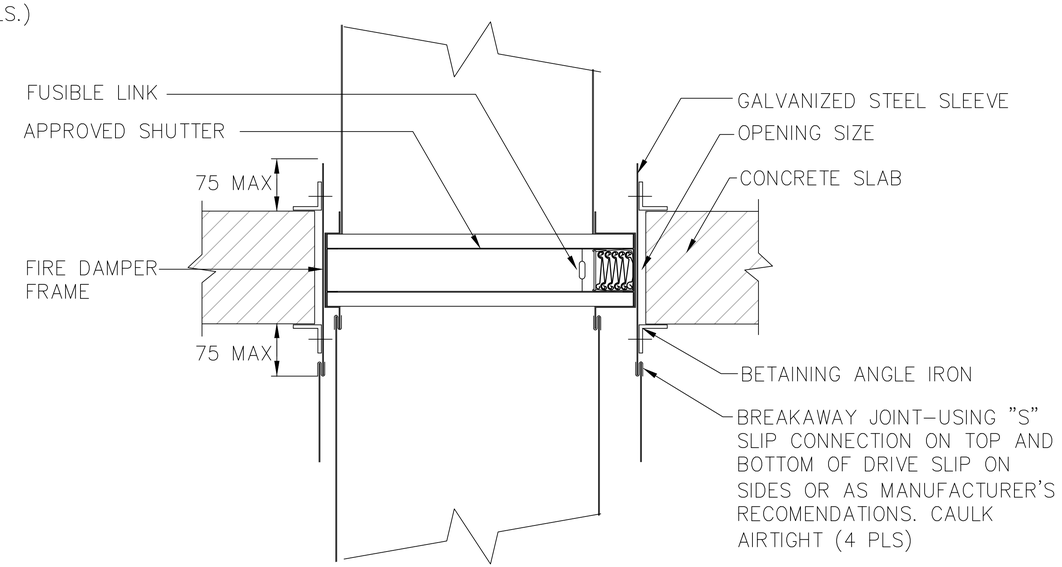
2 / M4.0 INSULATED PIPE HANGER DETAIL
Scale: N.T.S.



NOTE:

MIN DUCT SIZE 225X225 WITH
150X150 ACCESS PANEL

3 / M4.0 SHUTTER TYPE FIRE DAMPER–HORIZONTAL AIR FLOW
Scale: N.T.S.



4 / M4.0 SHUTTER TYPE FIRE DAMPER–VERTICAL AIR FLOW
Scale: N.T.S.

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3209 OCEANVIEW DRIVE
DAAJING GIIDS, BC

DRAWING NAME:
DETAILS

PROJECT NUMBER:
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APPROVED BY:	SA
SCALE:	REFER TO VIEWS

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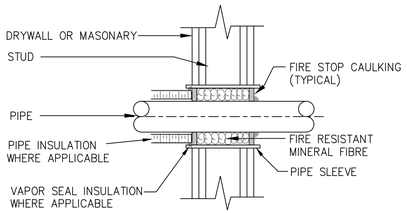
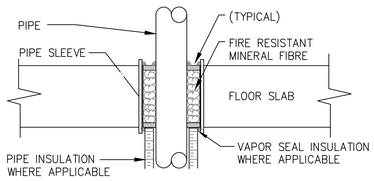


FIRE STOPPING AT PENETRATION OF VERTICAL FIRE SEPARATION

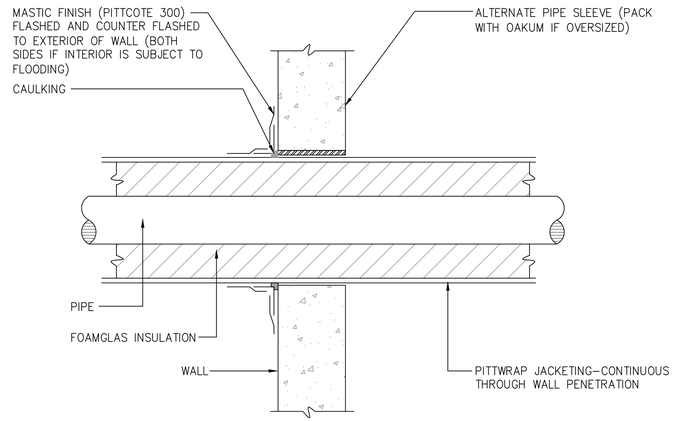


FIRE STOPPING AT PENETRATION OF HORIZONTAL FIRE SEPARATION

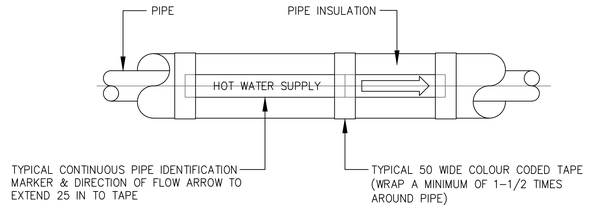
NOTES

1. PENETRATIONS THROUGH 2hr. FIRE RATED PARKADE CEILING SLAB ARE TO BE 2hr. F AND T AS PER CAN/ULC S115.
2. THICKNESS OF FIRE RESISTANT MINERAL FIBRE AND FIRE STOP CAULKING AS REQUIRED FOR FIRE SEPARATION RATING.
3. FIRE STOPPING SHALL BE INSTALLED BY A QUALIFIED APPLICATOR.
4. ALTERNATE FIRE STOPPING SEALANT ASSEMBLY TO BE SUBMITTED FOR APPROVAL PRIOR TO INSTALLATION.
5. SHOP DWGS. REQUIRED TO BE SUBMITTED PRIOR TO CONCRETE POUR FOR FIRE STOPPING ITEMS/SYSTEMS RELATED TO PARKADE CEILING SLAB.

1 / M4.1 PIPE FIRE STOPPING DETAIL
Scale: N.T.S.



2 / M4.1 WALL PENTRATION
Scale: N.T.S.



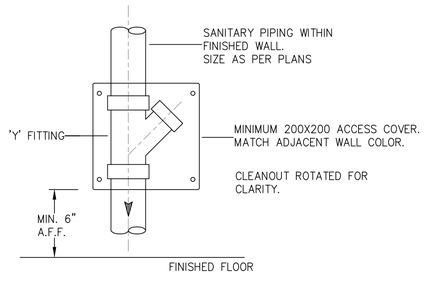
NOTES

APPLY A CONTINUOUS COATING OF CONTACT CEMENT TO THE LABEL TO ENSURE PERMANENT ADHESION

REFER TO SPECIFICATION FOR COLOUR CODING OF SERVICES

INSTALL AT 15000 INTERVALS (MAXIMUM) AND AT EACH CHANGE DIRECTION.

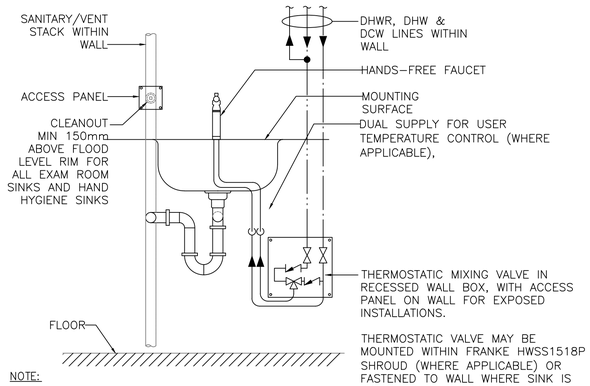
3 / M4.1 PIPE IDENTIFICATION DETAIL
Scale: N.T.S.



NOTE:

CLEANOUTS TO BE INSTALLED IN CONCEALED LOCATIONS WHEREVER POSSIBLE. (IE. CABINETS, BELOW COUNTERS, ETC.)
IN FINISHED ARERAS WHERE THIS IS NOT ACHIEVABLE,CONSULT WITH MECHANICAL ENGINEER PRIOR TO INSTALLATION.

4 / M4.1 WALL CLEANOUT DETAIL
Scale: N.T.S.



NOTE:

HIDE CLEANOUT BEHIND MIRROR WHERE POSSIBLE COORDINATE LOCATION WITH PAPER TOWEL DISPENSER, SOAP, GLOVE DISPENSER ETC.

5 / M4.1 LAVATORY SINK INSTALLATION DETAIL
Scale: N.T.S.

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PROJECT:
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DRAWING NAME:
DETAILS

PROJECT NUMBER:
24348-V

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SCALE:	REFER TO VIEWS

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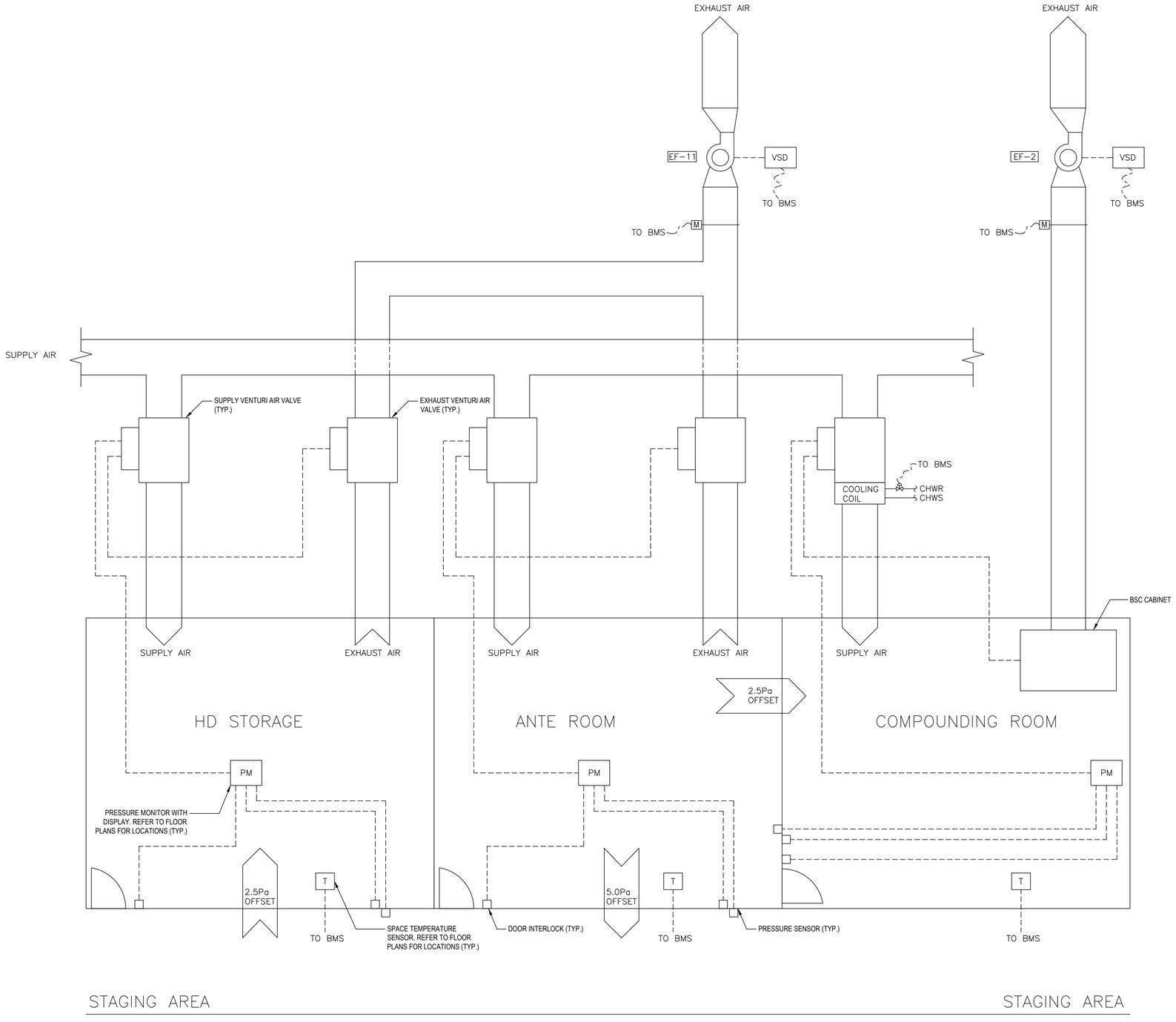

1 / M4.2 PHARMACY SUITE – SCHEMATIC
Scale: N.T.S.

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DRAWING:

M4.2

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HAIDA GWAII PHARMACY RENOVATION

Mechanical Specifications
Issued for Tender

Prepared by:

Rocky Point Engineering
#502-211 E. Georgia St.
Vancouver, BC
V6A 1Z6

Project No. #24348-V

1 GENERAL

1.1 References

.1 The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.2 Application

.1 This Section specifies requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.3 Note Re: Bold Lettering

.1 "**Bold**" type lettering is used throughout this Specification in an attempt to enhance the readability of the text. The use of "**bold**" lettering does not indicate a greater level of importance.

1.4 Submittals

.1 As specified in this Section, submit the following to the Consultant:
- .1 **Notice for field reviews:** written notice for attendance at the site for field reviews.
- .2 **Project close-out documentation:** O & M Manuals, record as-built drawings, and all associated data.
- .3 **Progress payment breakdown:** a detailed breakdown of the mechanical work cost.
- .4 **Contractor's P.Eng. Documentation:** the name, qualifications, and evidence of current liability insurance for all professional engineers to be retained by the Contractor to perform work associated with the Contract.
- .5 **Extended Warranties:** copies of all extended warranties specified, and in the name of the Owner.
- .6 **O & M Training Schedules & Modules:** a proposed schedule of demonstration and training dates and times.

1.5 Definitions

.1 The following are definitions of words found in mechanical work Sections of the Specification and on associated drawings:
- .1 "Concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls, and partitions.
- .2 "Exposed" – means work normally visible, including work in equipment rooms and similar spaces.
- .3 "Provide" (and tenses of provide) – means supply and install complete.
- .4 "Install" (and tenses of install) – means install and connect complete.
- .5 "Supply" – means supply only.
- .6 "Finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished.
- .7 "Governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the mechanical work and to which the work must adhere.
- .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner.

.2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.

.3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant. In the mechanical specification, singular may be read as plural, and vice-versa.

1.6 Quality Assurance

.1 All mechanical work shall be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen shall be limited and the journeyman/apprentice ratio is 1 journeyman for every 2 apprentices.

.2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.

.3 An experienced and qualified superintendent shall be on-site at all times when mechanical work is being performed.

.4 Submit to the Consultant for review, a Quality Assurance Programme within 21 days of Contract award. Upon review and acceptance, the programme shall be implemented for the duration of the Contract.

1.7 Codes, Regulations, and Standards

.1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time of issue of a building permit or bidding on this Project, whichever comes first.

.2 All work shall be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities, including:

.1 The British Columbia Building Code.
.2 The British Columbia Plumbing Code
.3 Inspection branches of Technical Safety BC.
.4 Technical Safety BC.
.5 WorkSafe BC
.6 Canadian Standards Association
Municipal and City ByLaws
.7 British Columbia Electrical Code
.8 Canadian Standards Association (CSA Z317.1, Z317.2, Z7396.1 & Z8000)

.3 All mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA Standard B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.

.4 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted. Pay all associated costs associated with these submittals.

.5 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

.6 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

.7 Ventilation systems and equipment are to be installed and conform to ASHRAE and SMACNA standards.

1.8 Imperial and Metric Measurements

.1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.

.2 If both Metric and Imperial units of measurement are indicated in the Mechanical Specification, Metric measurements are "soft" and have been rounded off.

1.9 Examination of Site and Documents

.1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all of the bid documents and visit the site to determine and review all existing site

conditions that will or may affect the work, and include for all such conditions in the bid price.

.2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.10 Drawings and Specification

.1 Read the mechanical work drawings in conjunction with all other structural, architectural, sprinkler, electrical, etc., drawings and, where applicable, the Code Consultant's report.

.2 The mechanical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.

.3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details not shown on the drawings.

.4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.

.5 Sections of the mechanical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.

.6 The mechanical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.

.7 The mechanical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.

.8 The mechanical drawings and specifications have been prepared solely for the use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.

.9 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.11 Planning and Layout of The Work, and Associated Drawings

.1 Properly plan, coordinate, and establish the locations and routing of services with general contractor and all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services shall be as follows:

- .1 Piping requiring uniform pitch.
- .2 Piping 100 mm (4") diameter and larger.
- .3 Large ducts (main runs).
- .4 Electrical cable tray and bus duct.
- .5 Conduit 100 mm (4") diameter and larger.
- .6 Piping less than 100 mm (4") diameter.
- .7 Smaller branch ductwork.
- .8 Conduit less than 100 mm (4") diameter.

.2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install piping, ductwork, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work and where location of valves and equipment requiring maintenance access appears to be too high for ease of access.

.3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.

.4 All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.5 Relocate improperly located holes and sleeves.

.6 Drill for expansion bolts, hanger rods, brackets and supports. Obtain written approval from Consultant prior to altering structural members.

.7 **Layout Drawings**: Do not use the Contract Drawing measurements for prefabrication and layout of piping and sheet metal work. Locations and routing are to generally be in accordance with the Contract Drawings, however, layout drawings are to be prepared for all such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with the Contract Drawings, notify the Consultant prior to proceeding with the work.

1.12 Alteration Works

.1 Where existing utilities are removed, relocated, or abandoned, cap, valve, plug, or by-pass to make a complete and working installation.

.2 A “complete and working installation” includes providing new surfaces identical to the ones removed or disturbed and matching adjacent surfaces with no visible difference between new and existing.

.3 Where repainting of a surface is required, paint the entire surface between the nearest adjacent corners, i.e. the entire plane of the surface containing the disturbed area.

.4 Where concealed conditions differ from those indicated on the drawings, immediately notify the Consultant.

1.13 Coordination of the Work

.1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:

- .1 Preparation of electronic coordination drawings as required, submitted as for shop drawings, with drawing scale as required to indicate the necessary details.
- .2 Written notification of all concrete work such as housekeeping pads, sumps, bases, etc., required for mechanical work, and including required dimensions, operating weight of equipment, location, etc.
- .3 Depth and routing of excavation required for mechanical work, and requirements for bedding and backfill.
- .4 Schematic wiring for all wiring work required for mechanical equipment and systems but not specified to be done as part of the mechanical work, including termination points, wiring type and size, and any other requirements.

1.14 General Re: Installation of Equipment

.1 Unless otherwise specified all equipment shall be installed in accordance with the equipment manufacturer's recommendations and instructions, Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.

.2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.

1.15 Energy Efficiency Standards

.1 All applicable mechanical equipment has been selected to meet energy efficiency requirements of the Model National Energy Code of Canada for Buildings or ANSI/ASHRAE/IESNA 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 Permits, Fees, and Certificates

.1 Apply for, obtain and pay for all permits required to complete the mechanical work.

.2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.

.3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.17 Workplace Safety

.1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.

.2 Comply with all requirements of WorkSafe BC Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.

1.18 Fall Restraint for Roof Mounted Equipment

.1 Wherever possible, locate roof mounted mechanical equipment or access hatch a minimum of 2 m from the edge of any roof 3 m or higher above the surrounding grade.

.2 Where mechanical equipment or hatches are located within 2 m from the edge of any roof 3 m or higher above the surrounding grade, supply roof anchors (a minimum of 2 per piece of equipment or roof hatch) capable of withstanding a minimum live load of 800 lb. in any direction and to which personal fall restraint equipment can be secured, and coordinate installation with the roofing trade. Refer also to Part 11 of the WorkSafe BC Occupational Health and Safety Regulations.

.3 Retain the services of a Professional Engineer registered in the Province of British Columbia to ensure that the fall restraint anchors provided are of adequate capacity and correctly installed, and to certify in writing (with signed professional stamp) that the anchor installations have been inspected on-site and are correctly installed and of adequate capacity. Submit the certification to the Consultant.

1.19 Shop Drawings and Product Data Sheets

.1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.

.2 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.

.3 Unless otherwise specified or required, submit shop drawings/product data sheets via email in AutoCAD or PDF format only.

.4 Wherever possible, shop drawings and/or product data sheets are to be 216 mm x 280 mm (8½" x 11"), 216 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17"), with sufficient clear space for review stamps, comments, and identification as specified below.

.5 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.

.6 Each shop drawing or product data sheet shall be properly identified with the project name and the product drawing or specification reference, i.e. "Exhaust Fan EF-1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.

.7 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure that this requirement is clearly indicated on the submission.

.8 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance with All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval as above.

.9 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:

.1 "**Reviewed**" **or** "**Reviewed as Modified**" to indicate that his review is final and no re-submittal is required.

.2 "**Revise and Resubmit**" to indicate that the submission is rejected and shall be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted.

.3 **"Not Reviewed"** to indicate that the submission has not been reviewed.

.10 The following shall be read in conjunction with the wording on the Consultant's review stamp applied to each and every mechanical work shop drawing or product data sheet submitted:

"This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

1.20 Changes or Revisions to the Work

.1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.

.2 Your quotation shall be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.

.3 Unless otherwise stated in the Contract Documents, the following requirements apply to all quotations submitted:

.1 When the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) shall be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work.

.2 Costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work.

.3 Cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary.

.4 Costs for rental tools and/or equipment are not to exceed local rental costs.

.5 If overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for overhead and profit are to be 10% and 10% respectively.

.6 The overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials, and rentals.

.7 All quotations, including those for deleted work, must include a figure for any required change to the Contract time.

.4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.

.5 If, in your opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.

.6 Do not execute any change or revision until written authorization for the change or revision has been obtained

1.21 Notice for Required Field Reviews

.1 Whenever there is a requirement for the Consultant to perform a field review and/or inspection prior to concealment of any work (including piping/duct system leakage testing, to inspect/re-inspect the work for deficiencies prior to Substantial Performance, for commissioning demonstrations, and any other such field review, give the Consultant a minimum of 72 hours written notice.

.2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.

.3 Do not conceal work until the Consultant advises that it may be concealed.

.4 When the Consultant is requested to perform a field review and the work is not ready to be reviewed, reimburse the Consultant for all time and travel expenses.

1.22 Scaffolding, Rigging, and Hoisting

.1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

.2 Do not place major erection loads on any portion of the structure without approval from the Consultant.

1.23 Trial Usage

.1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with the Specification and governing Codes and Regulations, prior to Substantial Performance of the work.

.2 When, in the opinion of the Consultant, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.

.3 All tests are not to be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the equipment or system due to the test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.

.4 When, in the Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from the site and replace them with acceptable equipment and/or products, at no additional cost.

1.24 General Re: Project Closeout Submittals

.1 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following. Items in **bold** are minimum requirements for Occupancy:
- .1 Operating and Maintenance Manuals.
- .2 As-built record drawings and associated data.
- .3 Extended warranties for equipment as specified.
- .4 Mechanical equipment start-up reports
- .5 Chemical cleaning & treatment report
- .6 Duct cleaning report
- .7 **Pressure test reports for piping systems**
- .8 **Fire-stop certificate**
- .9 **Fire damper test report**
- .10 Valve tag schedule
- .11 Megger test report for heat tracing
- .12 **Refrigeration final certificate**
- .13 **AHJ Certificates of completion: Gas Inspector, Boiler inspector, Plumbing Inspector**
- .14 **Letters of Assurance (schedules S-B and S-C) from contractor retained engineers (ie Seismic, etc.)**
- .15 **Fire damper test reports**
- .16 **Backflow prevention assembly device test reports**
- .17 Final commissioning report from commissioning agent
- .18 Final TAB report from TAB contractor
- .19 Identified keys for mechanical equipment and/or panels for which keys are required, and all other items required to be submitted.
- .20 Letter signed by Owner and Contractor stating that all spare items as identified below or otherwise in the specification have been handed over and received by the Owner. Items include but are not limited to:
  - .1 Spare HVAC filters
  - .2 Spare keys to any lockable doors, cabinets, etc.
- .21 Owner controls system demonstration
- .22 Written verification that all systems complete and fully operational or a complete list of items that are not finished or are deficient.

1.25 Operating and Maintenance Manuals

.1 Submit 1 hard copy of operating and maintenance manuals consolidated in hardcover 3 "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently with the Project name, "MECHANICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:
- .1 An Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses.
- .2 A Table of Contents sheet, and corresponding index tab sheets.
- .3 A copy of each "Reviewed" status shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service.

.4 Pressure leakage test reports for all piping systems.
.5 Certificates issued by governing authorities.
.6 **Operating Data:** Operating data shall include:
  .1 A description of each system and its controls.
  .2 Control schematics for equipment/systems including building environmental controls.
  .3 If applicable, the building automation system (bas) “as-built” architecture and all required operating data.
  .4 Description of operation of each system at various loads together with reset schedules and seasonal variances.
  .5 Operation instruction for each system and each component.
  .6 Description of actions to be taken in event of emergencies and/or equipment failure.
  .7 Valve tag schedule, and flow diagrams to indicate valve locations.
.7 **Maintenance Data:** Maintenance data shall include:
  .1 Servicing maintenance, operation and trouble-shooting instructions for each item of equipment and each system.
  .2 Schedules of tasks, frequency, tools required, and estimated task time.
  .3 Complete parts lists with numbers.
.8 **Performance Data:** Performance data shall include:
  .1 Equipment and system start-up data sheets.
  .2 Copies of all signed and dated piping system leakage test data.
  .3 Equipment performance verification test results, and final commissioning report.
  .4 Final testing adjusting and balancing reports.
.9 **Review Submittal:** Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions, and assembling the remaining copies. Incorporate all comments into the final submission.
.10 **Digital O & M Manuals:** Submit digital version of the hard copy manual using the latest version of Adobe Acrobat Portable Document format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to a USB Flash Drive with custom label indicating the project name, date, the Consultant’s name, and "Operating & Maintenance Manual for Mechanical Systems".

1.26 Record "As-Built" Drawings and Data

.1 As work progresses at the site, clearly mark in red “as -built” conditions in a neat and legible manner on a set of white print drawings printed from a PDF of the mechanical drawings supplied by the Consultant. Drawings will be kept on site at all times and available for reference.

.2 “As-Built” conditions include all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions.

.3 Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
  .1 The size, location, route, and extent of ductwork, piping, control devices and wiring conduit, cleanouts, valves, and similar items.
  .2 The dimensioned location of all inaccessible concealed work the locations of control devices with identification for each.
  .3 The location of all piping system air vents and water hammer arrestors.
  .4 The location and tag identification for all tagged valves.
  .5 For underground piping, including service entrance/exit piping, record dimensions, invert elevations, all offsets, fittings, cathodic protection and accessories if applicable, including invert elevations for underground drainage piping at each cleanout, manhole, and change in direction both inside and outside the building, and locate dimensions from benchmarks that will be preserved after construction is complete.

.6 For fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings.

.7 The location of all concealed services terminated for future extension.

.4 **Review and Submittal:** Prior to Substantial Performance of the work, and after the red line site as-built white prints have been transferred to PDF electronic files, plot a set of bond prints the electronic file as-built drawings, neatly add the notation 'CERTIFIED RECORD DRAWINGS", date and sign the bond prints, and submit the prints and the electronic files to the Consultant for review. The Consultant will review the drawings and, if necessary, return the electronic files and the marked-up prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the electronic files and vellum prints until they are determined to be acceptable, all prior to Substantial Performance.

1.27 Progress Payment Breakdown

.1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the mechanical work to assist the Consultant in reviewing and approving monthly progress payment claims.

.2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown shall include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, and project closeout submittals.

.3 Equipment, material and labour costs are to be indicated for site services (if applicable), plumbing and drainage, fire protection, HVAC piping, HVAC sheet metal, controls, and insulation work, etc., in the same manner as they will be indicated on the monthly progress draw.

1.28 Requirements for Contractor Retained Engineers

.1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. seismic engineer, fire protection engineer, structural engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.

.2 Your engineer's professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.

.3 Liability insurance requirements are as follows:

.1 Coverage shall be a minimum of $1,000,000.00 inclusive of any one occurrence.

.2 The insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice.

.3 Liability insurance shall be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work.

.4 Evidence of the required liability insurance in such form as may be required shall be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services.

1.29 Guarantee-Warranty

.1 The Contractor shall furnish a written warranty stating that all work executed will be free from defects of material and workmanship for a period of one year from the date of total performance. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.

.2 The Contractor further agrees that they will, at their own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guarantee-warranty

1.30 Extended Warranties

.1 All extended warranties specified in mechanical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct and in writing from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.31 Healthcare Facility Infection Control and Standards

.1 The following CAN/CSA Standards apply to the work of this Project and are to be adhered to:
- .1 CAN/CSA-Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities.
- .2 CAN/CSA-Z317.1, Special Requirements for Plumbing Installations in Healthcare Facilities.

1.32 Equipment and System Manufacturer's Certification

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.33 Equipment and System Start-Up

.1 When installation of equipment/systems is complete, but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with the following requirements:
- .1 Submit a copy of each equipment/system manufacturer's blank start-up report sheet to the Consultant for review and incorporate any comments.
- .2 Under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor.

1.34 Equipment and System Commissioning

.1 After successful start-up and prior to Substantial Performance, commission the mechanical work in accordance with requirements of CSA Z320, Building Commissioning. Use commissioning sheets included with the CSA Standard, and any supplemental commissioning sheets required. Submit final commissioning data sheets, TAB reports, project closeout documents, and other required submittals.

.2 Commission mechanical equipment and systems in accordance with the Section entitled Mechanical Work Commissioning.

1.35 Equipment and System O & M Demonstration & Training

.1 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in mechanical work Sections of the Specification. All demonstrations and training shall be performed by qualified technicians employed by the equipment/system manufacturer/supplier. The number of hours of training and the number of Owner's personnel to be involved will be specified in the mechanical work Sections to which this Section applies.

.2 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:

.1 **Operational Requirements and Criteria:** Requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations.

.2 **Troubleshooting:** Troubleshooting shall include but not be limited to diagnostic instructions, test and inspection procedures.

.3 **Documentation:** Documentation shall include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like.

.4 **Maintenance:** Maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools.

.5 **Repairs:** Repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.3 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days notice.

.4 The following sub-contractors are required to participate and assist with the demonstration and training session:

.1 Controls

.2 Balancing

.3 Manufacturer's representative for the following equipment:

.1 Custom Air Handling Units

.2 Variable Frequency Drives

.5 **Demonstration and Training Confirmation:** Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 NOT APPLICABLE

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more mechanical work Sections of the Specification, and it is intended as a supplement to each Section and shall be read accordingly.

1.2 Submittals

.1 Submit the following for review:
- .1 **Product data sheets:** submit for:
  - .1 Pressure gauges and thermometers.
  - .2 Electric motors (submit with equipment they are associated with).
- .2 **Access door locations:** submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas.
- .3 **List of equipment nameplates:** submit a list of equipment identification nameplates indicating proposed wording and sizes.
- .4 **Pipe & duct identification:** submit a list of pipe and duct identification colour coding and wording.
- .5 **Valve tag chart:** submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- .6 **Drive belts:** as specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.
- .7 **Piping pressure and temperature access fitting test kit:** submit a hinged case with pressure gauge and a thermometer, each with an adapter for a piping access fitting.

.2 **Additional submittals:** submit any other submittals specified in this Section or other mechanical work Sections of the Specification.

1.3 Equipment and Material Manufacturer Requirements

.1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.

.2 Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.

.3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

1.4 Substituted or Alternative Products

.1 Products supplied by a manufacturer/supplier other than a manufacturer specified as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, by fax, or by email. Telephone requests will not be considered.

.2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.

.3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified or acceptable products and the dimensions of such products differ from the specified or acceptable products, prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

.4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.5 Products – Base Bid and Acceptable Manufacturers

PRODUCT	APPROVED MANUFACTURER
Access Doors	Acudor, E.H. Price, Maxam, Milcor, Mifab, Enpoco
Commissioning Agencies	Western, MDT Systems Ltd., KD Engineering, Kane Consulting, Raincity
Control Dampers – Low Leakage	American Warming, Tamco, Ruskin
Controls – DDC	Delta Controls (Ainsworth)
Dampers – Fire and Smoke	Canadian Advanced Air, Maxam, Ruskin, Controlled Air, Nailor Industries, Pottoroff
Duct Cleaning	Enviro-Vac, Ace Mobile, Power Suction Services
Duct Silencers	Vibro Acoustics, VAW Systems
Ductwork – Flexible	Thermaflex, Wiremold, Flexmaster, Canaflex
Expansion Compensation - Piping	Mason Industries inc., The Metraflex Co., Hyspan Precision Products Inc., Flexicraft Industries, Senior Flexonics
Fans – Centrifugal Utility Blowers	Loren Cook Co., Greenheck, Twin City Fan & Blower
Fans – In-Line Centrifugal	Greenheck Fan Corp., Twin-City Fan and Blower, Loren Cook Co.,
Filters	Farr, Continental, Cambridge, AAF
Firestopping and Smoke Seals	3M Canada "Fire Barrier", Tremco Inc. Fire Protection Systems Group "TREMstop", Hilti (Canada) Ltd. Firestop Systems
Flow and Pressure Switches	Potter, System Sensor
Grilles, Registers and Diffusers	Titus, Tuttle & Bailey, Price Industries Inc., Nailor Industries, Krueger Division of Air System Components Inc.
Identification – Pipe and Duct	3M, SMS, Duramark, Bradley
Insulation – Piping and Duct	3M, Dow, Fibrex, Knauf, Johns-Manville, Owens Corning, Pittsburgh Corning, Manson, Roxul, Fibreglass Canada, Certainteed
Insulation Jacketing	Childers, Fiberglass, Johns-Manville
Pipe Couplings – Grooved	Victaulic, Grinnell, Shur Joint (confirm approved manufacturer based on each PM)
Pipe Couplings – Di-Electric	Watts, AG Specialties

PRODUCT	APPROVED MANUFACTURER
Pipe Couplings – Flexible	Mason, Flexonics, Hyspan, Goodall, Victaulic, Proco
Pipe Fittings and Flanges	Crane, Grinnell, Jenkins
Pipe Supports and Hangers	Crane, Unistrut, Myatt, Grinnell, Sarco, Hunt, Taylor
Plumbing Fixtures	Refer to Section 22 42 00
Pressure Gauges	Weiss, Ashcroft, Trerice, Marsh, Winter, Miljoco
Pressure Reducing Valves	Watts, Singer
Pressure Relief Valves	ITT Bell & Gossett 3301/4100 or 790/1170, Spirax Sarco ltd. SVI Series, McDonnell & Miller Models 250 & 260, Watts Industries (Canada) inc. 174A or 740, Conbraco 10-600 Series
Seismic Control and Restraint	Mason Industries Inc., Vibro-Acoustics Ltd.,
Strainers	Red & White, Sarco, Armstrong, Mueller, Watts, Conbraco
Testing, Adjusting and Balancing Agencies	Western Mechanical, KD Engineering, Airmec, Kane, Precision-Air, Raincity Technical Services, Tempest
Thermometers	Weiss, Ashcroft, Trerice, Marsh, Winter, Miljoco
Valves (Ball, Gate, Globe, Check)	Red & White/Toyo, Grinnell, Watts, Kitz, Crane, Milwaukee, Conbraco
Valves (Butterfly)	Red & White/Toyo, Grinnell, Kitz, Crane, Milwaukee, Keystone, DeZurik, Lukenheimer
Valves (Balancing)	Armstrong, DeZurik, Grinnell
Valves (Circuit Balancing)	Tour & Anderson, Bell & Gossett, Armstrong, Griswald, RWV
Variable Air Terminal Units	Titus, EH Price
Variable Frequency Drives	Yaskawa, Danfoss, Baldor, Hitachi, ABB, Siemens
Venturi Air Valves	Phoenix Controls, Antec
Vibration Isolation	Refer to section 20 05 20 for specific applications

2 PRODUCTS

2.1 Pipe Sleeves

.1 **Galvanized Sheet Steel:** Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.

.2 **Polyethylene:** Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.3 **Waterproof Sleeves:** Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint, or PSI-Thunderline “Century-Line” Model CS HDPE sleeves.

.4 **Galvanized Steel or Cast Iron Pipe:** Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.2 Firestopping and Smoke Seal Materials

.1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Division 07 and the work will be done as part of the work of Division 07.

.2 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in the mechanical work Section entitled Firestopping and Smoke Seal Systems and the work shall be done as part of the mechanical work.

2.3 Waterproofing Seal Materials

.1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size.

2.4 Pipe Escutcheon Plates

.1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the pipe sleeve or building surface opening, and to fit tightly around the pipe or pipe insulation.

2.5 Piping Hangers and Supports

.1 **General:** Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with the Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to the following requirements:
- .1 Unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized.
- .2 Hangers and supports for insulated piping are to be sized to fit around the insulation and the insulation jacket.

.2 **Horizontal Suspended Piping:** Hangers and supports are to be:
- .1 Adjustable steel clevis hanger – Anvil Fig. 260 – MSS Type 1.
- .2 Adjustable swivel ring band type hanger – Anvil Fig. 69 – MSS Type 10.
- .3 Adjustable roller hanger – Anvil Fig's. 171, 177 & 181 – MSS Types 41, 43, and/or 45, with Anvil Fig. 160 to166a – MSS Type 39 steel protection saddle.

.3 **Horizontal Pipe on Vertical Surfaces:** Epoxy coated steel pipe stays are not permitted. Supports are to be:
- .1 Steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170.
- .2 Heavy-duty steel pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26.
- .3 Single steel pipe hook - Myatt Fig. 156.

.4 **Floor Supports for Vertical Risers:** Supports are to be:
- .1 Copper tubing riser clamp – Anvil Fig. CT-121, Anvil Fig. CT-121C (plastic coated), or Myatt Fig. 150CT – MSS Type 8.
- .2 Heavy-duty steel riser clamp – Anvil Fig. 261, or Myatt Fig's. 182, 183, 190 and 191 – MSS Type 8.

.5 **Vertical Piping on Vertical Surfaces:** Epoxy coated steel pipe stays are not permitted. Supports are to be:
- .1 Steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170.
- .2 Heavy-duty steel pipe bracket or soil pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26.
- .3 Extension split pipe clamp – Anvil Fig's. 138R or Myatt Fig. 129 – MSS Type 12.

.6 **Base of Vertical Risers:** Support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment shall consist of a base elbow support with flange equal to Empire tool & Mfg. Co. Fig. 830.

.7 **Horizontal Pipe on Racks:** Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
- .1 Standard galvanized steel U-bolts/clamps supplied by the rack manufacturer.
- .2 Adjustable roller chair - Anvil Fig. 175 with Fig. 160-165 steel protection saddle.

.8 **Special Hangers and Supports:** Special hangers and supports for various applications are as follows:
- .1 **Vibration isolated riser supports** – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between the clamp and the floor.
- .2 **For groups of pipes having the same slope** – Anvil Fig. 195 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place.
- .3 **For sections of piping connected to vibration isolated equipment** – hangers and supports as specified above but complete with MSS Type 48 spring cushions.
- .4 **For piping on an existing roof** – Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit the pipe, complete with all required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and/or supports conforming to MSS SP-58.
- .5 **For plastic piping above ground** – generally as specified above but in accordance with the pipe manufacturer's printed recommendations.
- .6 **For bare horizontal copper piping** – generally as above but factory vinyl coated to prevent direct copper/steel contact.
- .7 **For bare copper vertical piping** – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate the pipe from the clamp.
- .8 **For embedded (in concrete) PVC piping**: special site fabricated galvanized steel pipe clamp support assembly with vertical rods, a Unistrut or equal base secured to base reinforcing steel, and guy wire, designed to be adjustable for proper piping slope and to secure the piping in position during the concrete pour.
- .9 **Insulation protection shields to & including 40 mm (1½") diameter** – equal to Anvil "Rib-Lok" Fig. 168 galvanized steel shields with ribs to keep the shield centred on the hanger.

.9 **Hanger Rods:** Electro-galvanized carbon steel (unless otherwise specified), round, threaded, complete with captive machine nuts with washers at hangers, sized to suit the loading in accordance with Table 3 in MSS SP-58, but, in any case, minimum 9.5 mm (3/8") diameter and in accordance with ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000PSI Tensile Strength, and ASME B18.31.3, Threaded Rods (Inch Series).

2.6 Equipment Bases and Supports

.1 **Concrete Housekeeping Pads:** Unless otherwise specified, shown or required, minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:
- .1 Supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads.
- .2 Place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment.
- .3 As a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.

.2 **Roof or Grade Metal Frame Supports:** Equal to Eco Support Products "EcoFoot-EcoFrame metal framework support assemblies, each sized to suit the equipment to be

mounted and consisting of UV stabilized rubber base mats, support legs adjustable from 300 mm to 450 mm (12” to 18”), galvanized steel fixings for the tubing framework, 15 mm (½”) diameter bolts, 50 mm (2”) square hot dipped galvanized mild steel tubing.

.3 **Structural Steel Stands/Supports:** for equipment not designed for base mounting, where required, provide welded or bolted, cleaned and galvanized, prime coat painted structural steel stands or supports conforming to the following requirements:
- .1 All stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review.
- .2 All steel stands are to be flange bolted to concrete housekeeping pads.

.4 **Access Platforms and Miscellaneous Steel Work:** Provide welded or bolted, cleaned, galvanized and prime coat painted structural steel platforms where shown for service access to equipment. Access platforms are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed shop drawings with calculations are to be submitted as shop drawings for review. Service access platforms are to conform to the following requirements:
- .1 Platforms are to be in accordance with OSHA requirements and are to be adequately sized, braced, anchored, and, as required, seismically restrained.
- .2 Flooring shall be Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), or equal, welded steel bar type grating.
- .3 Support legs are to be welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced.
- .4 Safety guard rails, constructed from minimum 32 mm (1¼") diameter Schedule 40 black steel pipe are to be provided for all platforms and are to be complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at the floor.
- .5 Vertical ladders are to be constructed of Schedule 40 black steel pipe, 25 mm (1") diameter for equal height rungs, 40 mm (1½") for stringers, anchored to floors and walls and sway braced as required.
- .6 Ships ladders, which are to used wherever space conditions permit, are to be of welded steel construction, are to climb at an approximate 60º angle, and are to be complete with channel iron stringers, open grate equal height risers approximately 165 mm (6½") wide and factory made by the grating manufacturer, handrails, and suitable anchoring and support.

2.7 Piping Strainers – “Y” Shaped

.1 Wye shaped strainers, bronze with sweat type or flanged connections in copper piping, cast iron with screwed, flanged, or grooved end connections in steel piping, minimum 1725 kPa (250 psi) rated and complete with a removable perforated type 304 stainless steel 20 mesh screen, and, for strainers 40 mm (1½") diameter and larger, a blow down pipe connection tapping.

2.8 Piping Drain Valves

.1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") diameter, straight pattern full port bronze ball valves, each complete with a lever handle, threaded outlet suitable for coupling connection of 20 mm (¾") diameter garden hose, and a cap and chain.

2.9 Access Doors

.1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16 gauge frame, minimum #18 gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it shall be installed.

.2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but, in any case, they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

.3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.

.4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.

2.10 Pressure Gauge and Thermometer Access Fittings

.1 Peterson Equipment Co. Inc. “Pete’s Plug II” threaded, piping mounting temperature and pressure test plug with two self-closing valves, each 3450 kPa (500 psi) rated and 135º C (275º F) rated, each equipped with a cap and restraining strap and a gasket, and, for insulated piping, “XL” extra length to accommodate the insulation.

.2 Supply a #1500 pressure and temperature test kit and submit as specified in Part 1 of this Section.

2.11 Pressure Gauges and Thermometers

.1 **Pressure Gauges:** Adjustable, glycerine filled, 100 mm or 115 mm (4" or 4½") diameter, each accurate to within 1% of scale range and complete with a type 304 stainless steel case with relief valve and polished stainless steel bayonet, stainless steel rotary movement with stainless steel bushings and socket, a clear acrylic window, a dual scale white dial with a scale range such that the working pressure of the system is at the approximate mid-point of the scale, and black pointer.

.2 **Pressure Gauge Accessories & Additional Requirements:** Accessories and additional requirements are as follows:

- .1 A bronze ball type shut-off valve shall be provided in the piping to each pressure gauge.
- .2 Each pressure gauge for piping and equipment with normal everyday flow shall be equipped with a brass pressure snubber.
- .3 Each pressure gauge for steam piping or steam equipment shall be equipped with a steel coil syphon.
- .4 Pressure gauges in fire protection piping must be ULC listed and labelled.
- .5 Pressure gauges in medical gas piping systems are to conform to CSA Z7396.1 and are to be identified with the name of the service it is provided for as well as "USE NO OIL".
- .6 Wetted parts of pressure gauges in domestic water piping are to be ANSI/NSF 61 certified lead free.

.3 **Thermometers:** Round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale and complete with a hermetically sealed stainless steel case with stainless steel ring, dampened bimetal coil, calibration adjustment screw, white aluminum dual scale dial with black and blue markings and a range such that the working temperature of the system is the approximate mid-point of the scale, black aluminum pointer, double strength glass window, 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem, a suitable thermowell, and, for thermometers in domestic water piping, ANSI/NSF 61 lead free certification.

2.12 Equipment Belt Drives

.1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times the motor nameplate rating, and in accordance with the following requirements:

- .1 Belts are to be reinforced cord and rubber, and multiple belts are to be matched sets.
- .2 Sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch (± 10% range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of the mechanical work to suit system air/water quantity testing and balancing work.
- .3 Motor slide rail adjustment plates are to allow for centre line adjustment.

.2 Supply a spare belt set (tagged and identified) for each belt drive and hand to the Owner upon Substantial Performance of the work.

2.13 Equipment Drive Guards and Accessories

.1 **For V-belt drives** - removable, four sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing the guard, and 40 mm (1½") diameter tachometer openings at each shaft location.

.2 **For flexible couplings** - removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.

.3 **For unprotected fan inlets & outlets** - unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

2.14 Electric Motors

.1 Unless otherwise specified, motors are to conform to EEMAC Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.

.2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.

.3 **AC Motor Efficiency:** The efficiency of single phase AC motors to 1 HP shall be in accordance with CAN/CSA C747. The efficiency of all three phase motors 1 HP and larger shall be in accordance with CAN/CSA C390 or IEEE 112B.

.4 **Single Phase AC Motors:** Unless otherwise specified, AC motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an EEMAC 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.

.5 **Brushless DC Motors:** Energy efficient electronically commutated motors (ECM) are to be brushless DC motors with an integral inverter, a permanent magnet on the rotor, and a programmable microprocessor based motor controller which will accept a remote adjustment signal for integration into a DDC building automation system

.6 **Three Phase AC Motors:** Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3 phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on the Drawings, EEMAC Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.5 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling the motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.

.7 **Motors for VFD's:** Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1, Section IV, Part 31, quantified by CSA for operation from a variable frequency drive of the type specified, and complete with Class "H" insulation and a shaft grounding bearing protection ring.

.8 **Corrosion Protection:** Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.

2.15 Motor Starters and Accessories

.1 Loose motor starters and accessories, disconnect switches, and motor control centres for mechanical equipment will be provided as part of the electrical work.

2.16 Mechanical Work Identification Materials

.1 **Equipment Nameplates:** Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:

.1 Unless otherwise specified or required, each nameplate shall be white, complete with bevelled edges and black engraved capital letter wording to completely identify the equipment and its use with no abbreviations.

.2 Wording is generally to be as per the drawings, i.e. Fan ef-1, and shall include equipment service and building area/zone served, but must be reviewed prior to engraving.

.3 Supply stainless steel screws for securing nameplates in place.

.4 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.

.2 **Valve Tags:** Coloured, 40 mm (1½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match the piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V2

100 mm (4")

CHILL. WATER

NORMALLY OPEN

.3 **Standard Pipe Identification:** Standard pipe identification shall be equal to Smillie McAdams Summerlin Ltd. or Brady vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:

.1 For pipe to and including 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around the pipe or pipe insulation.

.2 For pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

.4 **Standard Pipe Identification Wording and Colours:** Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
Domestic cold water	Green	DOM. COLD WATER
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic hot water recirculation	Green	DOM. HW RECIRC.
Tempered domestic water	Green	TEMP. DOM. WATER
Storm drainage	Green	STORM
Sanitary drainage	Green	SAN.
Plumbing vent	Green	SAN. VENT

.5 **Colours for Legends & Arrows:** Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
Yellow	Black

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
Green	White
Red	White

.6 **Duct Identification:** Custom made Mylar stencils with 50 mm (2") high lettering to accurately describe the duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with the lettering background.

2.17 Flexible Connectors

.1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by the manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application.

3 EXECUTION

3.1 General Piping and Ductwork Installation Requirements

.1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant’s approval.

.2 Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.

.3 Install all pipes and ducts parallel to building lines and to each other.

.4 Neatly group and arrange all exposed work.

.5 **Service and Maintenance Access:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.

.6 **Dissimilar Metal Pipe Connections:** Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.

.7 **Cleaning:** Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.

.8 **Insulation Clearance:** Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around the pipe or duct, except for ductwork at fire barriers, in which case the insulation will be terminated at each side of the duct fire damper.

.9 **Surfaces to Receive Your Work:** Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.

.10 **Piping Rust and Dirt:** Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both shall be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is

complete or prior to being concealed from view. Where dirt is evident, clean the piping prior to being concealed.

.11 **Drain Pans:** Provide continuous galvanized sheet metal drip pan under all drain, water and water solution piping extending through all rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and all other spaces provided primarily for the installation of electrical equipment. Drip pans are to be complete with a drain pipe connection and drain piping shall be extended to the closest drain.

.12 **Repair of Finished Surfaces:** for factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work shall match the original finish. This requirement also applies to galvanized finishes.

.13 **Unions and Flanges:** Whether shown or specified on the drawings or not, provide screwed unions or flanges in all piping connections to equipment, and in regular intervals in new piping runs in excess of 12 m (40') to permit removal of sections of piping.

.14 **Elbows and Eccentric Reducers:** Unless otherwise specified and except where space limitations do not permit, all piping elbows are to be long radius. Eccentric reducers are to be installed with the straight side at the top of the piping.

3.2 Pipe Joint Requirements

.1 Do not make pipe joints in walls or slabs.

.2 Ream all piping ends prior to making joints.

.3 **Screwed Steel Piping:** Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.

.4 **Welded Steel Piping:** Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove all scale and oxide from the bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.

.5 **Welding Requirements:** Welded joints are to be made by CWB certified, currently licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed.

.1 Each weld shall be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved.

.2 Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.

.6 **Flanged Joints:** Unless otherwise specified, make all flanged joints with EDPM gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than the length necessary to screw the nut up flush to the end of the bolt. Bolts used for flanged connections in all piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193, Grade B-7, with heavy hexagon nuts to ASTM A-194, CL-2H. Provide suitable washers between each bolt head and the flange and between each nut and the flange.

.7 **Examination of Flanged Joints:** A random check of bolted flanged connections will be made to verify that flanged connections are properly mated with no shear force acting on bolts. Supply all labour to disconnect and reconnect the selected flanged joints. If improperly mated joints are found, remove and reinstall the affected piping so that the flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.

.8 **Soldered Joints:** Unless otherwise specified make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside

of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering. Comply with requirements of ASTM B828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

.9 **Mechanical Joints:** Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.

.10 **Grooved Pipe & Coupling Joints:** Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to the manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.

.11 **Pressure Crimped Piping Joints:** If pressure crimped couplings and fittings are used, ensure that gaskets are fully compatible with the piping fluid, and that all valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with the manufacturer’s latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.

.12 **PVC Piping Solvent Weld Joints:** Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with the manufacturer’s recommendations, ASTM D2855, and CSA requirements.

.13 **PVC Piping Gasketed Joints:** Install PVC piping with gasketed joints in accordance with the manufacturer’s current published specifications, instructions and recommendations, and CSA requirements.

3.3 Installation of Pipe Sleeves

.1 Where pipes pass through new concrete and/or masonry surfaces provide pipe sleeves as follows:
- .1 **In poured concrete slabs:** unless otherwise specified - minimum #16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves.
- .2 **In concrete or masonry walls:** Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.

.2 **Waterproof Sleeves:** Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a water stop plate in accordance with the drawing detail. Provide waterproof sleeves in the following locations:
- .1 In mechanical room floor slabs, except where on grade.
- .2 In slabs over mechanical, fan, electrical and telephone equipment rooms or closets.
- .3 In all floors equipped with waterproof membranes.
- .4 In the roof slab.
- .5 In waterproof walls.

.3 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around the pipes, or where the pipe is insulated, a 12 mm (½") clearance around the pipe insulation.

.4 Pack and seal the void between the pipe sleeves and the pipe or pipe insulation in non-fire rated construction for the length of the sleeves as follows:
- .1 **Interior construction:** pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound.
- .2 **Exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.
- .3 **Exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

.5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.

.6 Terminate piping for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.

.7 "Gang" type sleeving will not be permitted.

.8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening.

3.4 Installation of Waterproof Mechanical Seals

.1 Provide watertight link type mechanical seals in exterior wall openings where shown or specified.

.2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.

.3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

3.5 Duct Openings

.1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.

.2 Ensure that openings for fire dampers to 600 mm (24") high are sized to suit the damper arrangement with the folding blade out of the air stream.

.3 For all duct openings except where fire dampers are required, pack and seal the space between the duct or duct insulation and the duct opening as specified above for pipe openings in non-fire rated construction.

3.6 Sleeve and formed Opening Location Drawings

.1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in new poured or precast concrete work.

.2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.

.3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.7 Installation of Pipe Escutcheon Plates

.1 Provide escutcheon plates suitable secured over all new exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.

.2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate shall fit tightly around the sleeve.

3.8 Installation of Fastening and Securing Hardware

.1 Provide all fastening and securing hardware required for mechanical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components. Submit support details for review prior to installation.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and CAN3-Z166.2.

.5 Do not attach fasteners to steel deck without written consent from the Consultant.

3.9 Installation of Pipe Hangers and Supports

.1 Provide all required pipe hangers and supports.

.2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from the structure only.

.3 **For Insulated Pipe:** Size the hanger or support to suit the diameter of the insulated pipe and install the hanger or support on the outside of the insulation and insulation finish.

.4 **Horizontal Above Ground Piping:** Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe to and including 25 mm (1") diameter are to be clevis type or adjustable ring type, and hangers for suspended pipe 40 mm (1½") diameter and larger are to be adjustable clevis type. Space hangers and supports in accordance with the following:

.1 **Cast iron pipe:** hang or support at every joint with maximum 2.4 m (8') spacing.

.2 **Plastic pipe:** conform to pipe manufacturer's recommended support spacing.

.3 **Glass pipe:** conform to pipe manufacturer's recommended support spacing and support requirements.

.4 **Copper and steel pipe:** hang or support at spacing in accordance with the following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
To 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

.5 **Flexible grooved pipe/coupling joint piping:** as above but with not less than 1 hanger or support between joints.

.6 **Changes in direction:** where pipes change direction, either horizontally or vertically, provide a hanger or support on the horizontal pipe not more than 300 mm (12") from the elbow, and where pipes drop from tee branches, support the tees in both directions not more than 50 mm (2") on each side of the tee.

.7 **Grouped piping:** when pipes with the same slope are grouped and a common hanger or support is used, space the hanger or support to suit the spacing requirement of the smallest pipe in the group and secure pipes in place on the common hanger or support.

.8 **Roller hangers & supports:** provide roller hangers or supports for all heat transfer piping 150 mm (6") diameter and larger and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to the pipe to protect the piping insulation.

.5 **Vertical Piping:** Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with the following:

.1 Support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser.

.2 For sections of vertical piping with a length less than 3 m (10'), support the pipe at least once.

.3 For all vertical cast iron plain end pipe (mechanical joint type), secure the riser or pipe clamp around the pipe under a flange integral with the pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support.

.4 For all vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to the pipe to carry the load.

.5 For vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between the riser clamps and the floor.

.6 For piping subject to vertical movement exceeding 40 mm (1½") due to vertical pipe expansion, provide suitable engineered constant support hangers.

.6 **Piping on The Roof:** Support piping on the roof in accordance with requirements of the drawing detail.

.7 **Piping on The Roof:** Support piping on the roof as follows:

.1 **On existing roof** - provide support members as specified in Part 2 of this Section spaced as per the schedule above and of a type to suit the application, and, for each support, carefully scrape away the roofing gravel, bed the support in a heavy covering of roofing mastic, then scrape the gravel back up around the support - secure pipes to supports

.8 **Isolation for Bare Copper Tubing:** Each hanger, support or securement for horizontal bare copper tubing shall be plastic coated to prevent direct contact between the pipe and the ferrous hanger. Each wall or floor clamp for vertical bare copper piping shall be isolated from the pipe by means of strips of flexible rubber inserts. The use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

.9 **Insulation Protection Shields:** for insulated horizontal piping to and including 40 mm (1½") diameter, provide galvanized steel insulation protection shields between the insulation and the hanger or support. Install shields immediately after the pipe is insulated.

.10 **Pipe Support from Steel Deck:** Do not support piping from steel deck without written consent from the Consultant.

3.10 Installation of Pipeline Strainers

.1 Provide strainers in piping systems where shown on the drawings.

.2 Equip each strainer with a construction screen and remove after piping has been flushed and cleaned. Install permanent screens/mesh.

.3 Provide isolating valves in piping a maximum of 3 m (10') from the strainer on each side of a strainer.

.4 For "Y" shaped strainers 40 mm (1½") diameter and larger, provide blow-off piping complete with a shut-off valve with cap and chain, and terminate blow-off piping downward in a vertical position.

.5 For duplex basket strainers, equip each chamber drain plug with valved drain piping.

3.11 Installation of Equipment Drains and Piping Drain Valves

.1 Unless otherwise shown or specified, provide minimum 40 mm (1½") diameter type DWV copper drain piping from equipment overflows, condensate drain pans, pump bases, fresh air intake plenum drains, etc., to a floor drain location. Equip the drain piping with deep seal traps located in heated areas.

.2 Provide a drain valve at the bottom of piping risers, at all other piping low points, and wherever else shown and/or specified.

.3 Locate drain valves so that they are easily accessible.

3.12 Supply of Access Doors

.1 Supply access doors to give access to all mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.

.2 Locate access doors as inconspicuously as possible in walls and partitions and arrange mechanical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.

.3 Group piping and ductwork to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.

.4 Submit a sample of each proposed access door for review prior to ordering.

.5 Identify access doors supplied for concealed medical gas system shut-off valves or equipment with a permanent label in accordance with requirements of CAN/CSA Standard Z7396.1.

3.13 General Re: Installation of Valves

.1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where the valves are specified, however, regardless of locations shown or specified, the following requirements apply:

- .1 Provide shut-off valves to isolate all systems, at the base of all vertical risers, in branch take-offs at mains and risers on all floors, to isolate all equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance.
- .2 Install shut-off valves with handles upright or horizontal, not inverted, and located for easy access.
- .3 Unless otherwise specified, provide a check valve in the discharge piping of each pump.
- .4 Valve sizes are to be the same as the connecting pipe size.
- .5 Valves are to be permanently identified with the size, manufacturer's name and figure number, and wherever possible, valves are to be the product of the same manufacturer.
- .6 The manufacturer's name, valve model or figure number, and the pressure rating are to be clearly marked on each valve.
- .7 For valves in insulated piping, the design of the valve stem, handle and operating mechanism shall be such that the insulation does not have to be cut or altered in any manner to permit valve operation. Provide valve extensions to allow for insulation of piping and valves to maintain consistent thickness while maintaining proper operation. Do not cut into the insulation to provide access to the vaves.

3.14 Installation of Pressure Gauge & Thermometer Access Fittings

.1 Provide pressure gauge and thermometer access fittings in 6.4 mm (¼") threaded opening fittings for insertion/removal of piping mounted pressure gauges and thermometers. Where piping is insulated, provide extended length access fittings to accommodate the insulation.

.2 Unless pressure gauges and/or thermometers are provided with equipment, provide access fittings in the following locations:
- .1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.
- .2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.
- .3 In expansion tank(s) or piping immediately at the expansion tank.
- .4 In all water connections to hot water heaters.
- .5 In the downstream side of mixing valves.
- .6 In separate domestic hot water storage tank(s).
- .7 At the top most outlet in each standpipe fire protection system riser.
- .8 In piping at each side of a pressure reducing valve.
- .9 In domestic water service piping downstream of the meter.
- .10 Wherever else shown and/or specified on the drawings or in the Specification.

.3 All metal surfaces that are in contact with domestic water are to be NSF/ANSI 61 certified.

3.15 Installation of Pressure Gauges and Thermometers

.1 **Pressure Gauges**: Provide pressure gauges in the following locations:
- .1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.
- .2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.
- .3 In expansion tank(s) or piping immediately at the expansion tank.
- .4 In separate domestic hot water storage tank(s).
- .5 At the topmost outlet in each standpipe fire protection system riser.
- .6 In piping at each side of a pressure reducing valve.
- .7 In domestic water service piping downstream of the meter.
- .8 Wherever else shown and/or specified on the drawings or in the Specification.

.2 **Thermometers:** Provide thermometers in the following locations:
- .1 In supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, liquid to liquid heat exchangers, main coils, etc., unless temperature indication is supplied with the equipment.
- .2 In all water piping connections to hot water heaters.
- .3 In the downstream side of mixing valves.
- .4 Wherever else shown and/or specified herein or on the drawings.

.3 **Installation Requirements:** Conform to the following installation requirements:
- .1 For installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in the piping well.
- .2 For pressure gauges in piping at equipment locations, install the pressure gauge between the equipment and the first pipe fitting.
- .3 Locate, mount, and adjust all instruments so they are easily readable.
- .4 Where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.
- .5 All metal surfaces that are in contact with domestic water are to be NSF/ANSI 61 certified.

3.16 Installation of Equipment Drive Guards and Accessories

.1 Provide OSHA guards for all exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on all mechanical equipment.

.2 Install belt guards to allow movement of motors for adjusting belt tension.

.3 Provide a means to permit lubrication and use of test instruments with guards in place.

.4 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.

.5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with the equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.17 Mechanical Work Identification

.1 Identify all new/relocated mechanical work in accordance with existing identification standards at the site.

.2 **Exposed Piping & Ductwork:** Identify new exposed piping and ductwork as per Part 2 of this Section in locations such that it can be seen from the floor or service platforms, as follows:
- .1 At every end of every piping or duct run.
- .2 Adjacent to each valve, strainer, damper, and similar accessory.
- .3 At each piece of connecting equipment.
- .4 On both sides of every pipe and duct passing through a floor, wall, or partition.
- .5 At 6 m (20') intervals on pipe and duct runs exceeding 6 m (20’) in length.
- .6 At least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.

.3 **Concealed Piping & Ductwork:** Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
- .1 At points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas.
- .2 At maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room.
- .3 At each access door location.
- .4 At each piece of connected equipment, automatic valve, etc.

.4 **Equipment:** Provide an identification nameplate for each new piece of equipment, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate all nameplates in the most conspicuous and readable location. Unless otherwise specified, equipment identification terminology shall be as per drawing identification.

.5 **Motor Starters and Disconnect Switches:** Provide an identification nameplate for each new motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter which you supply, and on each disconnect switch provided as part of the electrical work for motorized equipment which you provide.

.6 **Electrical Tracing:** for all new electrically traced mechanical work, identification wording shall include "ELECTRICALLY TRACED".

.7 **Valve Tagging & Chart:** Tag valves and prepare a valve tag chart in accordance with the following requirements:
- .1 Attach a valve tag to each new valve, except for valves located immediately at the equipment they control.
- .2 Prepare a computer printed valve tag chart to list all tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed).
- .3 If an existing valve tag chart is available at the site, valve tag numbering shall be an extension of existing numbering and the new valve tag chart shall incorporate the existing chart.
- .4 Frame and glaze one copy of the chart and, unless otherwise directed, affix to a wall in each main mechanical and/or equipment room.
- .5 Include a copy of the valve tag chart in each copy of the operating and maintenance instruction manuals.

.6 Hand an identified and packaged (jewel case) compact disc of the valve tag chart to the owner at the time the O & M Manuals are submitted.

.8 **Ceiling Tacks or Stickers:** Where new shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in the ceiling panel material, or stickers equal to Brady "Quick Dot" on the ceiling grid material to indicate locations of the items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1	HVAC piping valves and equipment	yellow
.2	Fire protection valves and equipment	red
.3	Plumbing valves and equipment	green
.4	HVAC ductwork dampers and equipment	blue
.5	Control system hardware and equipment	orange

3.18 Finish Painting of Mechanical Work

.1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of the painting Section in Division 09.

.2 Touch-up paint all damaged factory applied finishes on mechanical work products.

.3 Finish painting of exposed mechanical work is specified in Division 09 and is part of the work of Division 09.

3.19 Pipe Leakage Testing

.1 Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage.

.2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.

.3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.

.4 **Gravity Drainage & Vent Piping:** Securely close all openings and pipe ends and fill piping with water up to the highest level, and ensure that the water stands at the same level for a minimum of 2 hours. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test if required by the Municipality. at your option, drain and vent piping may be pressure tested with cold water at 345 kPa (50 psi) for 2 hours with zero leakage.

.5 **Domestic Water Piping:** Test piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of 2 hours.

.6 **Standpipe System Piping:** Test all system piping in accordance with requirements of NFPA No. 14, "STANDPIPE AND HOSE SYSTEMS", and in accordance with any additional requirements of governing authorities.

.7 **Refrigerant Piping:** Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of the ASHRAE HANDBOOK - FUNDAMENTALS.

.8 **General Re: All Testing:** The following requirements apply to all testing:

.1 Ensure that all piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing.

.2 Temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter.

.3 When testing is carried out below the highest level of the particular system, increase the test pressure by the hygrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point.
.4 Include for temporary piping connections required to properly complete the tests.
.5 Piping under test pressure shall have zero pressure drop for the length of the test period.
.6 Make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained.
.7 Where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions.
.8 Tests are to be done in reasonably sized sections so as to minimize the number of tests required.
.9 In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage, and Include for any necessary system adjustments to achieve the proper conditions.

3.20 Supply of Motor Starters and Accessories

.1 Motor starters for mechanical equipment, except for starters integral with packaged equipment and starters factory installed in equipment power and control panels, will be provided as part of the electrical work.

3.21 Electrical Wiring Work for Mechanical Work

.1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment will be done as part of the electrical work:
.1 "Line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment.
.2 "Line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment.
.3 "Line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment.
.4 Provision of receptacles for plug-in equipment.
.5 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring.
.6 All motor starter interlocking in excess of 24 volts.
.7 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts.
.8 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work.
.9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers.
.10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units.
.11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.
.12 120 volt wiring connections to line voltage thermastats.
.13 120 volt wiring connections to DDC controls transformers.
.14 All disconnects to be provided by Div. 26 unless otherwise noted.

.2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work shall be installed in conduit and shall be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

3.22 Interruption to and Shut-Down of Mechanical Services and Systems

.1 Co-ordinate all shut-down and interruption to existing mechanical systems with the Owner/Facilities Manager. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.

.2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform the Owner/Facilities Manager and Consultant in writing 72 hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

.5 **Pipe Freezing:** Pipe freezing is to be used to connect new piping to existing piping without draining the existing piping. Pipe freeze equipment shall be equal to "NORDIC FREEZE" CO2 equipment supplied by Mag tool Inc.

3.23 Installation of Equipment Bases and Supports

.1 **Concrete Housekeeping Pads:** Unless otherwise specified, shown, or required, set all floor or grade mounted equipment on reinforced concrete housekeeping pads.

.2 **Steel Framework Supports:** Where indicated, support base mounting smaller HVAC equipment such as heat pumps, condensing units, and fan equipment on galvanized steel adjustable tubular steel framework support assemblies.

.3 **Structural Steel Stands/Supports:** for equipment not designed for base mounting, where required, provide welded, cleaned, and prime coat painted structural steel stands or supports flange bolted to concrete housekeeping pads.

.4 **Access Platforms and Miscellaneous Steel Work:** Provide access platforms where shown for service access to equipment.

3.24 Mechanical Service Requirements for Floating Floor Slabs

.1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to the base slab on which the floating floor slab is placed.

.2 Wherever possible arrange mechanical work to avoid penetrating a floating floor slab.

3.25 Concrete Work for Mechanical Equipment Bases/Pads

.1 All concrete work required for mechanical equipment bases/pads will be provided as part of the concrete work of Division 03.

.2 Exactly locate bases/pads at the site and be present during the concrete pour to ensure that anchor bolts, inserts, plates, and similar hardware are not damaged or dislodged.

.3 Coordinate base/pad installations with the concrete trade and ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.26 Concrete Work for Mechanical Equipment Bases/Pads

.1 Provide all poured concrete work, including reinforcing and formwork, required for mechanical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.

.2 Concrete shall be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.

.3 Submit for review, dimensioned shop drawings for all concrete pads or bases for support of large, heavy equipment. Indicate on the shop drawings the total weight of the pad or base as well as the equipment it is provided for, and concrete reinforcing. Shop drawings are to be prepared and stamped by a professional structural engineer registered in the place of the work.

.4 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.27 Cutting and Patching for Mechanical Work

.1 All cutting and patching of existing building surfaces required for mechanical work, including core drilling walls and slabs for piping, will be done as part of another Division of the work and is excluded from the mechanical work.

.2 Accurately and carefully mark out the location and extent of cutting or drilling required and co-ordinate with the trade(s) performing the work. Note that the location and size of cut or drilled openings must be approved by the Consultant before the work commences, and all cut or drilled openings must not be larger than is absolutely necessary for installation of the pipe, duct, etc., and insulation where necessary.

3.28 Cutting, Drilling, and Patching for Mechanical Work

.1 Do all cutting, drilling and patching of the existing building for the installation of your work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.

.2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.

.3 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around the pipes or pipe insulation.

.4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan Test the walls or slabs if required.

.5 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your cutting or drilling work.

.6 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a pipe sleeve which is sized to leave 12 mm (½") clearance around the pipe or pipe insulation. Provide a pipe sleeve in the opening. Pipe sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

3.29 Packing and Sealing Core Drilled Pipe Openings

.1 Pack and seal the void between the pipe opening and the pipe or pipe insulation for the length of the opening as follows:

.1 **Non-fire rated interior construction:** pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal.

.2 **Exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.

.3 **Exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

3.30 Flashing for Mechanical Work Penetrating the Roof

.1 Do all required flashing work, including counterflashing, for mechanical work penetrating and/or set in the roof.

.2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.31 Cleaning Mechanical Work

.1 Refer to cleaning requirements specified in Division 01.

.2 Clean all mechanical work prior to application for Substantial Performance of the work.

.3 Include for vacuum cleaning the interior of air handling units and ductwork systems.

3.32 Use of Mechanical Systems for Temporary Heating

.1 Permanent building mechanical systems are not to be used for temporary heating purposes during construction.

.2 Permanent mechanical systems in the building may be used for temporary heating during construction subject to the following conditions:

- .1 Each entire system is complete, pressure tested, cleaned, and flushed out.
- .2 Specified water treatment system has been commissioned, and treatment is being continuously monitored.
- .3 Building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .4 There is no possibility of damage from any cause.
- .5 Supply ventilation systems are protected by minimum MERV 7 filters, which are to be inspected every other day, and changed every 2 weeks, or more frequently as required.
- .6 Return air systems have approved construction filters over all openings, inlets, and outlets.
- .7 All systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis.
- .8 Warranties are not affected in any way.
- .9 Regular preventive and all other manufacturer's recommended maintenance routines are performed.
- .10 Before Substantial Performance, each entire system shall be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced.
- .11 Energy costs are to be paid by the Contractor.

3.33 Maintaining Equipment Prior to Acceptance

.1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing, and commissioning.

.2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.

.3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.

.4 All filters are to be new upon Substantial Performance of the work. This is in addition to any spare filters specified.

3.34 Connections to Other Equipment

.1 Carefully examine the Contract Documents during the bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.35 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with requirements specified in Division 01.

.2 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.

.3 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.

.4 Place materials defined as hazardous or toxic waste in designated containers.

.5 Ensure emptied containers are sealed and stored safely for disposal.

3.36 Seismic Restraint Anchor Points for Equipment

.1 All mechanical equipment requiring seismic restraint (see the mechanical work Section entitled Seismic Control and Restraint) shall be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.

.2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

3.37 Installation of Flexible Connectors

.1 Provide flexible connectors in piping connections to all seismically restrained equipment, and wherever else shown.

.2 Provide flexible connectors in all piping connections to vibration isolated equipment.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies seismic control and restraint requirements that are common to mechanical work Sections of the Specification, it is a supplement to each Section and shall be read accordingly.

1.2 Seismic Consultant

.1 Retain and pay for the services of an experienced Seismic Consultant who is a registered professional engineer licensed in the jurisdiction of the work and a member in good standing of a Professional Engineers Association in the jurisdiction of the work.

.2 The Seismic Consultant shall:

.1 Determine the proper seismic hazard level, design, recommend, and review all proposed mechanical work seismic restraint shop, placement and securing drawings, and sign and stamp all drawings prior to submittal for review as specified below.

.2 Supervise installation of all mechanical work seismic restraint and, when work is complete, certify in writing that the seismic restraint work has been installed in accordance with signed, stamped, and reviewed drawings.

.3 Prepare and submit to the Municipality and authorities having jurisdiction, on a form approved by the Municipality and authorities having jurisdiction, at the beginning of seismic restraint work and when the work is complete, original signed and sealed Letters of Assurance for the design, installation and field review of all seismic restraint work.

1.3 Submittals

.1 **Shop Drawings/Product Data Sheets:** Obtain all required equipment information and submit manufacturer's shop drawings/product data sheets for all restraining devices and steel bases. Include placement data, and details of attachment to both the equipment and the structure meeting requirements of the forces involved. All product data sheets and drawings are to be signed and stamped by the Seismic Consultant referred to above.

.2 **Seismic Consultant's/Seismic Control Product Manufacturer's Certification Letters:** Submit copies of the Seismic Consultant's Letters of Assurance as specified above. Submit copies of the Seismic Consultant and seismic control manufacturer's certification letters as specified in Part 3 of this Section.

.3 **Samples:** If requested, submit samples of seismic restraint materials for review.

1.4 Quality Assurance

.1 Seismic restraints are to be designed by a Seismic Consultant as specified above, and are to be installed by qualified tradesmen under the supervision of and to the approval of the Seismic Consultant.

.2 Unless otherwise specified seismic control and restraints are to be designed in accordance with:

.1 BC Building Code.

.2 ANSI/SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

.3 CAN/CSA-S832, Seismic Risk Reduction of Operational and Functional Components (OFC’s) of Buildings.

.4 ANSI/SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.

.3 Seismic control and restraints for fire protection piping and equipment are to be in accordance with NFPA requirements. When specified and/or required, design is also to include Factory Mutual requirements.

2 PRODUCTS

2.1 General

.1 All restraint products must be tested in an independent testing laboratory, or certified by the Vibration Isolation and Seismic Control Manufacturer's Association and Seismic Consultant, to confirm that the restraint products meet all requirements of this Section.

3 EXECUTION

3.1 Installation of Seismic Restraint Materials

.1 Provide seismic restraint for all mechanical system equipment, piping, and ductwork, etc., as per the requirements of specified Codes and Standards.

3.2 Seismic Restraint of Piping Systems

.1 Provide seismic restrain for all new piping systems with the following exceptions:
- .1 Natural gas piping less than 25 mm (1") diameter.
- .2 Domestic water piping 32 mm (1¼") diameter and smaller in mechanical equipment rooms.
- .3 All other piping 65 mm (1½") diameter and smaller.
- .4 All piping suspended by individual hangers 300 mm (12") or less in length from the top of the pipe to the bottom of the hanger.

3.3 Seismic Restraint of Duct Systems

.1 Provide seismic restraint for all new ductwork systems with the following exceptions:
- .1 All rectangular ducts less than 0.56 sq. m (6 sq. ft.) in cross-sectional area.
- .2 All round ducts less than 710 mm (28") in diameter.
- .3 All ductwork suspended by individual hangers 300 mm (12") or less in length from the top of the duct to the bottom of the hanger.

3.4 Seismic Restraint for Motor Driven Equipment

.1 Connect slack cable restraints to ceiling hung or in-line pumps in such as way that the axial projection of the wires passes through the centre of gravity of the equipment. Orient the restraint wires at approximately 90º to each other (in plan), and tie back to the ceiling or structure above at an angle not exceeding 90º.

.2 Connect slack cable restraints to ceiling hung fans in such as way that the axial projection of the wires passes through the centre of gravity of the equipment. Orient the restraint wires at approximately 90º to each other (in plan), and tie back to the ceiling or structure above at an angle not exceeding 90º.

.3 Provide seismically rated spring mount isolators for fans installed on floor structures or inside air handling unit casings. Refer to the mechanical Section entitled Mechanical Vibration Control.

.4 For roof mounted fans supplied with seismically rated roof curbs, the Seismic Consultant shall determine the appropriate methods of attachment of the roof curbs to the roof structure.

3.5 Site Inspection and Letters of Certification

.1 When all seismic control products have been installed, arrange for the Seismic Consultant to examine the installation of all seismic control products and to certify in writing that the products have been properly installed in accordance with governing Codes and Regulations, reviewed shop drawings and product data, and recommendations and instructions. The Seismic Consultant shall apply his signed and dated professional stamp to the letter.

3.6 Seismic Restraint Anchor Points for Equipment

.1 All mechanical equipment requiring seismic restraint (see the mechanical work Section entitled Seismic Control and Restraint) shall be complete with manufacturer designed and

rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.

.2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

3.7 Installation of Flexible Connectors

.1 Provide flexible connectors in piping connections to all seismically restrained equipment, and wherever else shown.

.2 Provide flexible connectors in all piping connections to vibration isolated equipment.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies vibration isolation product requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

.2 All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.

.3 The work in this section includes, by is not limited to:
- .1 Vibration isolation for piping, ductwork and equipment
- .2 Equipment isolation bases
- .3 Flexible piping connections
- .4 Resilient Pipe Anchors and Guides

1.2 Submittals

.1 Submittals shall be based on actual equipment to be supplied to site and not necessarily the scheduled equipment when approved alternatives have been carried by the Contractor. Vibration isolation submittal shall be coordinated appropriately with other submittals as well as proposed means of installation.

.2 **Product Data:** Submit copies of manufacturer's product data sheets for all products specified in this Section. Product data sheets shall include:
- .1 Descriptive Data:
  - .1 Schedules of flexibly mounted equipment, referencing drawings by number
  - .2 Catalog cuts or data sheets on vibration isolators
- .2 Drawings:
  - .1 Submit details of equipment bases including dimensions, structural member sizes, and support point locations
  - .2 Submit details of isolation hangers for ceiling hung equipment, piping and ductwork
  - .3 Submit details of mountings for floor supported equipment, piping and ductwork
  - .4 All hanger, mounting or pad drawings shall indicate deflections and model numbers as well as any other requirements in the specifications.
  - .5 Spring diameters, rated loads, and deflections, heights at rated load and closed height shall be provided for all springs shown in the submittals in tabular form.

1.3 Quality Assurance

.1 Mechanical vibration isolation product manufacturers are to be current members of the Vibration Isolation & Seismic Restraint Manufacturers Association.

.2 All isolation materials shall be supplied by the same manufacturer.

.3 Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

1.4 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.

.2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:
- .1 Mason Industries Inc.
- .2 VMC Group.
- .3 Vibro-Acoustics by Swegon.

.4 Kinetics Noise Control.

1.5 Seismic Restraint Requirements

.1 Refer to the mechanical work Section entitled Seismic Control and Restraint for requirements for use of a Seismic Consultant, and seismic restraint requirements applicable to vibration isolated materials and equipment.

.2 Hangers used in seismic applications shall be provided with a neoprene and steel rebound washer installed 6mm (1/4") clear of bottom of hanger housing in operation to prevent spring from excessive upward travel.

2 PRODUCTS

2.1 General

.1 Vibration isolation products are to be in accordance with the drawing schedule and details, and as specified below.

.2 **Finishes:** All steel components of isolation products not exposed to the weather or moisture are to be zinc plated or finished in powder coated enamel. All steel components of isolation products exposed to the weather or in a damp, moist environment are to be hot dipped galvanized or factory finished with rust inhibiting primer and 2 coats of neoprene.

.3 Where the weight of isolated equipment may change significantly due to draining or filling with a liquid, vibration isolators are to be equipped with limit stops to limit spring extensions.

.4 **Seismic Rated Vibration Isolation:** All seismic restraints supplied with vibration isolation are to meet requirements specified in the mechanical work Section entitled Seismic Control and Restraint.

.5 **Flexible Piping Connections:** Flexible piping connections to vibration isolated equipment are specified in the appropriate piping sections of the Specification. Neoprene mountings shall have a minimum static deflection of 0.35"(9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Mountings shall be type ND or rails type RND as manufactured by Mason Industries, Inc.

2.2 Neoprene Mountings shall have a minimum static deflection of 0.35"(9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Mountings shall be type ND or rails type RND as manufactured by Mason Industries, Inc.

2.3 Pads Neoprene or neoprene/steel/neoprene pad isolators. Select Type 1 pads for minimum 2.5 mm static deflection or greater. Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene hemi-grommets. Avoid over-compressing grommets (e.g. use Hilti HVA adhesive set bolts, or equal, with steel washers and lock nuts, adjusted finger tight to hemi-grommets). Size bolt and hemi-grommet for minimum lateral clearance. Use grommets only on light-weight equipment.

.1 Acceptable Products: Mason WMW, Super W pads, Mason Industries Type HG Hemi-Grommets, EAR Grommets, Kinetics Noise Control Inc. Type RSP.

2.4 Rubber Floor Mounts: Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select for 4.0 mm minimum static deflection and bolt to structure. Rubber isolators, provide protection in design of isolator to avoid contact of rubber element to oil in mechanical room.

.1 Acceptable Products: Mason BR, maximum 50 durometer, Kinetics Noise Control Inc. Type RD, RQ.

2.5 **Spring Isolators** shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4”(6mm) neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be type SLF, as manufactured by Mason Industries, Inc.

2.6 **Spring Floor Mounts:** Spring mounts complete with levelling devices, selected to achieve 25 mm deflection under load. Spring to incorporate minimum 6.0 mm thick neoprene sound pad or cup having 1.3 mm minimum deflection under load. Design isolator to meet specified seismic requirements.

.1 Acceptable Products: Mason SSLFH, Mason SSLR (for chillers and cooling towers only), Kinetics Noise Control Inc. FLS.

2.7 **Hanger Mounts:** Spring hangers, complete with 6.0 mm thick neoprene cup/bushing sized for 1.3 mm minimum deflection, or neoprene hangers.

.1 Acceptable Products: Mason HD, HS, Kinetics Noise Control Inc. SH.

2.8 **Pipe Hangers (general)** shall consist of rigid steel frames containing minimum 1-1/4”(32mm) thick LDS Rubber elements at the top and a steel spring with general characteristics as in specification **2.5** seated in a steel washer reinforced LDS Rubber cup on the bottom. The LDS Rubber element and the cup shall have LDS Rubber bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the LDS Rubber element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.

2.9 **Duct Hangers** shall be manufactured with minimum characteristics as in Specification **2.5 (Spring Isolators)**, but without the LDS Rubber element. Springs are seated in a steel washer reinforced LDS Rubber cup that has an LDS Rubber bushing projecting through the bottom hole to prevent rod to hanger contact. Spring diameters and the lower hole sizes, shall be large enough to allow the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing. If ducts are suspended by flat strap iron, the hanger assembly shall be modified by the manufacturer with an eye on top of the box and on the bottom of the spring hanger rod to allow for bolting to the hanger straps. Submittals on either of the above hangers shall include a scale drawing of the hanger showing the 30° capability. Hangers for rods shall be Type 30 or for straps W30 as manufactured by Mason Industries, Inc.

2.10 **Horizontal Thrust Restraints for Fans:** when total air thrust exceeds 10% of the isolated weight, floor mounted or suspended air handling equipment shall be protected against excessive displacement by the use of horizontal thrust restraints. The restraint shall consist of a modified Specification **2.5 (Spring Isolators)** spring mounting. Restraint springs shall have the same deflection as the isolator springs. The assembly shall be preset at the factory and fine tuned in the field to allow for a maximum of 1/4” (6mm) movement from stop to maximum thrust. The assemblies shall be furnished with rod and angle brackets for attachment to both the equipment and duct work or the equipment and the structure. Restraints shall be attached at the center line of thrust and symmetrically on both sides of the unit. Horizontal thrust restraints shall be WB as manufactured by Mason Industries, Inc.

2.11 **Bases and Rails**

.1 Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14”

(356mm) provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1”(25mm). Bases shall be type WF as manufactured by Mason Industries, Inc.

.2 Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent distortion of equipment. Inverted saddles shall be type ICS, as manufactured by Mason Industries, Inc.

.3 Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating concrete bases. Bases for split case pumps shall be large enough to provide support for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6” (152mm). The base depth need not exceed 12” (305mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2” (13mm) bars welded in place on 6” (152mm) centers running both ways in a layer 11/2”(38mm) above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1” (25mm) clearance below the base. Wooden formed bases leaving a concrete rather then a steel finish are not acceptable. Base shall be type BMK or K as manufactured by Mason Industries, Inc.

2.12 **Rubber expansion joints** shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2” through 14”(40mm through 350mm) shall have a ductile iron external ring between the two spheres. Sizes 16” through 24” (400mm to 600mm) may be single sphere. Sizes 3/4” through 2”(19mm through 50mm) may have one sphere, bolted threaded flange assemblies and cable retention.

.1 Minimum ratings through 14”(350mm) shall be 250psi at 170°F and 215psi at 250°F. (1.72MPa at 77°C and 1.48MPa at 121°C), 16”(400mm) through 24”(600mm) 180psi at 170°F and 150psi at 250°F. (1.24MPa at 77°C and 1.03 MPa at 121°C). Higher published rated connectors may be used where required.

.2 Safety factors shall be a minimum of 3/1. All expansion joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment.

.3 The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 1/2”(13mm) thick Neoprene washer bushings large enough to take the thrust at 1000psi (0.7 kg/mm2) of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

2.13 **Flexible stainless steel hoses** with a safety factor of 4 shall be manufactured using type 304 stainless steel braided hose with one fixed and one floating raised face carbon steel plate flange. Sizes 2-1/2" (65mm) and smaller may have threaded nipples. Copper sweat ends, 4" (100mm) and smaller, may have SS (gas service) or Bronze (water service) bodies. Grooved ends may be used in sizes 2" (50mm) through 12" (300mm). Welding is not acceptable. Minimum lengths, minimum live lengths and minimum number of convolutions per foot to assure flexibility shall be as per Figure 1. Shorter lengths are not acceptable. Hoses shall be installed on the equipment side of the shut off valves horizontal and parallel to the equipment shafts wherever possible. Submittals shall include original test data showing force/displacement, fittings, material, live lengths, number of corrugations per foot and safety factor at pressure ratings. Hoses shall be type BSS or CPSB as manufactured by Mason Industries, Inc.

Pipe or Tubing Size (in) (mm)	Flanged Face to Face (in) (mm)	Flanged Live Length (in) (mm)	Threaded End to End (in) (mm)	Threaded Live Length (in) (mm)	Grooved Ends End to End (in) (mm)	Grooved Ends Live Length (in) (mm)	Copper Sweat Bronze End to End (in) (mm)	Copper Sweat Bronze Live Length (in) (mm)	Minimum Convolutions per (foot) (m)
1/2 *15*	–	–	24 *600*	19 3/4 *501*	–	–	18 *457*	14 1/4 *362*	92 *302*
3/4 *20*	–	–	24 *600*	19 3/4 *501*	–	–	18 *457*	13 3/4 *349*	80 *262*
1 *25*	–	–	24 *600*	19 3/4 *501*	–	–	18 *457*	13 3/8 *340*	72 *236*
1 1/4 *30*	–	–	24 *600*	18 3/4 *469*	–	–	18 *457*	13 1/4 *337*	67 *220*
1 1/2 *40*	24 *600*	21 7/8 *469*	24 *600*	18 3/4 *469*	–	–	18 *457*	13 *330*	63 *207*
2 *50*	24 *600*	21 1/8 *450*	24 *600*	18 *450*	24 *600*	18 *450*	18 *457*	12 1/2 *318*	58 *190*
2 1/2 *65*	24 *600*	21 1/8 *450*	24 *600*	17 *425*	24 *600*	18 *450*	18 *457*	10 3/4 *273*	48 *157*
3 *75*	36 *900*	33 1/8 *841*	36 *900*	29 *737*	36 *900*	30 *750*	18 *457*	10 1/2 *267*	46 *151*
4 *100*	36 *900*	33 1/8 *841*	36 *900*	29 *737*	36 *900*	28 *700*	18 *457*	15 1/2 *394*	32 *105*
5 *125*	36 *900*	32 7/8 *822*	–	–	36 *900*	28 *700*	–	–	29 *95*
6 *150*	36 *900*	32 7/8 *822*	–	–	36 *900*	28 *700*	–	–	25 *82*
8 *200*	36 *900*	32 5/8 *816*	–	–	36 *900*	28 *700*	–	–	23 *75*
10 *250*	36 *900*	32 5/8 *816*	–	–	36 *900*	26 *650*	–	–	21 *69*
12 *300*	36 *900*	32 5/8 *816*	–	–	36 *900*	26 *650*	–	–	20 *66*
14 *350*	36 *900*	32 5/8 *816*	–	–	–	–	–	–	18 *59*
16 *400*	36 *900*	32 5/8 *816*	–	–	–	–	–	–	16 *52*

Figure 1 - Flexible SS Hose Min. Convolutions per ft (m)

2.14 **Pipe Wall Penetrations:** where pipes pass through structural openings, the space shall be sealed by a 2 piece clamp lined with 3/4”(19mm) thick Neoprene Sponge. Concrete or block shall be poured or built around the clamp or back packed with concrete. 10 Lb. density fibreglass with caulked ends will replace the sponge where temperatures exceed 225°F (107°C). Seals shall be type SWS as manufactured by Mason Industries, Inc.

2.15 **All-directional acoustical pipe anchors,** consist of two sizes of steel tubing separated by a minimum 1/2”(13mm) thickness of 60 duro or softer LDS Rubber. Vertical restraint shall be provided by similar material arranged to prevent up or down vertical travel. Allowable loads on the isolation material shall not exceed 500 psi(3.45 N/mm2) and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc**.**

2.16 **Pipe guides** shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2”(13mm) thickness of 60 durometer or softer neoprene. The height of the guides shall be preset with a set screw to allow vertical motion due to pipe expansion or contraction. Guides shall be capable of ±15/8”(41mm) motion, or to meet location requirements. Pipe guides shall be type VSG as manufactured by Mason Industries, Inc.

2.17 **Flexible Duct Connections** shall be constructed from EPDM or neoprene. Install 75mm (3”) flexible duct connections with a minimum 40mm (1-1/2”) metal to metal gap. Flexible duct connections shall be installed so that the duct size is not reduced by the deflection of the flexible connector. Flexible connections shall be rated for duct system pressures and shall meet SMACNA pressure and leakage classifications of connected ductwork. Provide flanged connections to ductwork.

3 EXECUTION

3.1 Installation of Vibration Isolation Materials

.1 Provide vibration isolation products for mechanical work in accordance with the drawing schedule and details, and requirements specified herein and/or on the drawings.

.2 Supply to the vibration isolation product manufacturer or supplier a copy of a "Reviewed" shop drawing or product data sheet for each piece of equipment to be isolated, and dimensioned pipe layouts of associated piping to be isolated.

.3 Unless otherwise specified, all vibration isolation products are to be the product of one manufacturer.

.4 Ensure that the vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.

.5 Maintain a minimum clearance of 50 mm (2”) between vibration isolated equipment and adjacent structures, piping, ductwork, equipment, and similar items.

.6 Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stressed or misalignment.

.7 No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

.8 The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.

.9 Coordinate work with other trades to avoid rigid contact with the building.

.10 Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/ engineer’s attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor’s expense.

.11 Bring to the architects/engineer's attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.

.12 Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense

.13 Where piping passes through walls, floors, or ceilings the vibration isolation manufacturer shall provide split acoustic wall seals consisting of 19mm (3/4") thick closed cell neoprene sponge as per section **2.14**, Mason SWS or approved equal.

.14 Locate isolation hangers as near to the overhead support structure as possible.

.15 Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight. Horizontal thrust restraints shall be as per **2.10.**

.16 Rooftop equipment isolators must be bolted to the equipment and structure. Mountings must be designed to resist 100m/h(160 km/h) wind loads.

.17 Vibration Isolation of Horizontal Piping.

.1 The first four pipe hangers in the main lines near the mechanical equipment shall be as described in specification.
.2 Hangers supporting piping 2"(50mm) and larger in all other locations throughout the building shall be isolated by hangers as described in specification **2.3**.
.3 Floor supported piping shall rest on isolators as described in specification.
.4 Heat exchangers and expansion tanks are considered part of the piping run.
.5 The first four isolators from the isolated equipment shall have the same static deflection as specified for the mountings under the connected equipment.
.6 If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first four hangers shall have
  .1 0.75" (19mm) deflection for pipe sizes up to and including 3" (75mm),
  .2 1-1/2" (38mm) deflection for pipe sizes over 3" (75mm) and up to and including 6" (150mm), and
  .3 2-1/2" (64mm) deflection thereafter.
.7 Where piping connects to mechanical equipment install specification **2.12 Rubber Expansion Joints** or specification **2.13 Stainless Hoses** if **2.12** is not suitable for the service.
.8 All piping passing through the equipment walls, floors or ceilings shall be protected against sound leakage by means of an acoustical seal, as described in Specification **2.14.**

.18 Vibration Isolation of Riser Piping.

.1 All vertical risers shall be supported by spring isolators designed to support the riser filled with water, if it is a water line. Assigned loads must be within the building design limits at the support points. Neutral central resilient anchors close to the center of the run shall direct movement up and down. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. If one level cannot accommodate this force, anchors can be located on 2 or 3 adjacent floors.
.2 Resilient guides shall be spaced and sized properly depending on the pipe diameter.
.3 Submittals must include the initial load, initial deflection, change in deflection, final load and change in load at all spring and anchor support locations, as well as guide spacing. The initial spring deflection shall be a minimum of 0.75" (19mm) or four times the thermal movement at the isolator location, whichever is greater.
.4 Calculations shall include pipe stress at end conditions and branch off locations and the manufacturer must include installation instructions.
.5 Submittal must be stamped and signed by a licensed professional engineer in the employ of the vibration vendor for at least 5 years.
.6 Support spring mountings shall be per Specification **2.5**, anchors per Specification **2.15**, telescoping guides per Specification **2.16**.

.19 **Vibration Isolation of Ductwork**

.1 All air ducts with a cross section of 2 ft^2 (0.19m2) or larger shall be isolated from the building structure by specification **2.9 (Duct Hangers)** or **2.5 (Spring Isolators)** floor supports with a minimum deflection of 0.75”(19mm). Isolators shall continue for 50’(15m) from the equipment. If air velocity exceeds 1000 fpm(5.3mps), hangers or supports shall continue for an additional 50’(15m) or as shown on the drawings.

.2 Provide flexible duct connections on inlet and outlet of all centrifugal fans.

.20 **Control Wiring Connections:** for all control wiring connections to vibration isolated equipment ensure that flexible metallic conduit with 90°bend is used for conduit 25 mm (1") dia. and smaller, and for conduit larger than 25 mm (1") dia., use Crouse Hinds EC couplings. Connections are to be long enough so that the conduit will remain intact if the equipment moves 300 mm (12") laterally from its installed position, and flexible enough to transmit less vibration to the structure than is transmitted through the vibration isolation. Coordinate these requirements with the mechanical trades involved. If electrical power connections are not made in a similar manner as part of the electrical work, report this fact to the Consultant.

.21 **Seismic Restraint Isolation:** Refer to the mechanical work Section entitled Seismic Control and Restraint for requirements pertaining to seismically restrained vibration isolation.

.22 **Adjusting, Commissioning and Testing:**

.1 Adjust vibration isolators after piping systems are filled and equipment is at operating weight.

.2 Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

.3 For large rotating equipment that requires final alignment on-site, provide follow-up vibration isolation adjustment to suit final operating condition and any final equipment alignment requirements, ie for large base mounted pumps, fans, etc. Coordinate vibration isolation adjustment with start-up and commissioning personnel.

4 EQUIPMENT SCHEDULE

4.1

EQUIPMENT SCHEDULE			
EQUIPMENT TAG	Provided With Equipment	VIBRATION ISOLATION	
		Isolator, Base, Restraint, Flexible Connector Specification	Minimum Static Deflection
EF-2	Y	**Floor Mounted Spring Isolator**	**25**
EF-11	Y	**Ceiling Mounted Spring Isolator**	**25**

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies thermal insulation requirements that are common to mechanical work Sections of the Specification. It is a supplement to each Section and shall be read accordingly.

1.2 Submittals

.1 **Product Data Sheets & WHMIS Sheets:** Submit a product data sheet and a WHMIS sheet for each insulation system product. Product data sheets must confirm that the product conforms to requirements and insulation thickness of referenced Codes, Standards, and thermal conductivity and density values.

.2 **Insulation Systems:** Submit shop drawing of each system at least 4 weeks prior to insulation work commencing. Submit a shop drawing of each type of insulation for approval and identify each product with the manufacturer's name and insulation type. Work shall not proceed prior to approved shop drawing review.

.3 **Removable/Reusable Insulation Covers:** Submit a fabrication drawing for each custom made cover to indicate material and fabrication details, and a 300 mm (12") square sample of the proposed cover material.

1.3 Definitions

.1 "Concealed" means insulated mechanical services and equipment located in suspended ceiling spaces, non-accessible chases, and furred-in spaces.

.2 "Exposed" means not concealed as defined above and visible to building occupants.

.3 "Insulation system" means insulation material, fasteners, jacket, vapour barrier and any other accessory.

.4 "BCICA" means British Columbia Insulation Contractors Association.

.5 "Mineral fibre" means glass fibre, rock wool fibre, and slag wool fibre.

.6 "Domestic water" means all piping (cold, hot, tempered and re-circulation) extended from the building Municipal supply main.

.7 "WHMIS sheets" means Workplace Hazardous Materials Information System sheets

.8 "TIAC" means Thermal Insulation Association of Canada.

1.4 Quality Assurance

.1 **Insulation System Materials, Application, and Finishes:** Insulation system materials, application, and finishes must, as a minimum, conform to the standards listed in the current version of the BCICA "Quality Standards for Mechanical Insulation.

.2 **Insulation Values:** Minimum piping and duct insulation thickness / R values shall conform to the current version of National Energy Code for Canada for Buildings and ASHRAE 90.1 Section 6 - Heating, Ventilation and Air Conditioning & Section 7 – Service Water Heating.

.3 **Qualification of Applicators:** Mechanical insulation shall be applied by tradespersons with a BCICA membership and a Red Seal or TQ designation in the Heat and Frost Insulation Trade. Registered apprentice tradespersons must be under direct, daily, on-site supervision of a journeyman.

.4 Do not apply insulation unless leakage tests have been satisfactorily completed.

.5 Ensure that all surfaces to be insulated are clean and dry.

.6 Ensure that the ambient temperature is minimum 13°C (55°F) for at least one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.

.7 All insulation materials must be stored on site in a proper and dry storage area. Any wet or damaged insulation material shall be removed from the site and replaced.

2 PRODUCTS

2.1 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2.2 Fire Hazard Ratings

.1 Unless otherwise specified, all insulation system materials inside the building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.3 Thermal Performance

.1 Unless otherwise specified, thermal performance, i.e. conductivity, of insulation shall meet or exceed the values given in the current version of the National Energy Code of Canada for Buildings and ANSI/IES/ASHRAE Standard 90.1.

.2 Insulation thickness around pipe fittings, including shoulders and hardware, to be the same installed thickness as the adjacent or adjoining pipe insulation. Pipe and fitting insulation to be equal thickness and thermal performance throughout the entire system.

.3 Pipe insulation to be continuous through hanging supports, walls, ceilings and floors. Hangers, supports, anchors, etc. that are secured directly to cold surfaces (ie: piping) will be adequately insulated and vapor sealed to prevent condensation.

2.4 Pipe Insulation Materials

.1 **Horizontal Pipe Insulation at Hangers & Supports:** Equal to Shur Fit Products “Pro-Pipe Support” or Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, premoulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and Kraft paper vapour barrier jacket and a 180°captive galvanized steel saddle.

.2 **Specialty insulation for Piping:** Factory fabricated foamed glass or closed cell foamed plastic insulation fittings specifically made for pipe mechanical joint fittings and couplings, and pipe risers at riser clamps. Equal to Armacell Canada Inc. or Owens Corning “FOAMGLASS”.

.3 **BCICA Standard 1501, Type A2, Preformed Mineral Fibre:** Rigid, sectional, sleeve type insulation to ASTM Standard C 547, Standard Specification for Mineral Fibre Pipe Insulation, supplied in 915 mm (3’) lengths with a factory applied vapour barrier jacket and adhesive jacket closure.to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, with a minimum thermal conductivity of 0.033 W @ 24°C.

.1 Johns Manville Inc. "Micro-Lok AP-T Plus"

.2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket

.3 Manson Insulation Inc. "ALLEY K APT"

.4 Owens Corning Fiberglas Pipe Insulation

.4 **BCICA Standard 1501,Type A2 ,Preformed Non-Combustible Mineral Fibre:** Rigid, sectional, sleeve type insulation to ASTM Standard C 547, Standard Specification for Mineral Fibre Pipe Insulation, minimum thermal conductivity of 0.047 @ 93°C, supplied in 915 mm (3’) lengths with a factory applied vapour barrier jacket and adhesive jacket closure, and non-combustible, in accordance with requirements of CAN/ULC-S114, Test for Non-Combustibility, and compatible with firestopping as per CAN/ULC-S101, Fire Endurance Tests of Building Construction and Materials.

.1 Roxul “Techton 1200”

.2 Paroc 1200

.5 **BCICA Standard 1501, Type A5, Flexible Foam Elastomeric:** Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation in accordance with requirements of ASTM C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form, with all required installation accessories. Acceptable products are:

.1 Armacell AP/Armaflex SS

.2 Aeroflex “Aerocel SSPT”

.3 K-FLEX USA TITAN

.6 **BCICA Standard 1501, Type A7, Closed Cell Foamed Glass:** Expanded, sectional, rigid sleeve type insulation manufactured in accordance with requirements of ASTM C552, Standard Specification for Cellular Glass Thermal Insulation, minimum thermal conductivity of 0.027 W @ 24°C, minimum density of 32 kg/m³, and equipped with a factory applied self-sealing jacket. Pittsburgh Corning "FOAMGLASS” with a factory applied "PITTWRAP SSII" self-sealing jacket, or equivalent.

2.5 Barrier-Free Lavatory/Sink Piping Insulation Kits

.1 Removable, flexible, reusable, white moulded PVC insulation kits with internal fasteners for barrier-free fixture drain piping and domestic water supplies exposed under the fixture.

2.6 Ductwork System Insulation Materials

.1 **BCICA Standard 1502, Type A2, Rigid Mineral Fibre Board:** Preformed board type insulation to ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation, with a factory applied reinforced aluminum foil and kraft paper facing.

.1 Knauf Fiber Glass Insulation Board with FSK facing

.2 Manson Insulation Inc. "AK BOARD FSK"

.3 Johns Manville Inc. Type 814 "Spin-Glas"

.4 Owens Corning 703, 704

.2 **BCICA Standard 1502, Type B2, Flexible Mineral Fibre:** Roll form insulation to ASTM C1393, Standard Specification for Perpendicularly Oriented Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks, with a factory applied vapour barrier facing consisting of consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing.

.1 Multi-Glass Insulation Ltd. "Multi-Flex MKF"

.2 Glass-Cell Fabricators Ltd. "R-FLEX"

.3 Owens Corning Pipe and Tank Insulation

.3 **Blanket Mineral Fibre:** Blanket type roll form insulation to ASTM Standard C553, Standard Specification for Mineral Fibre Blanket Thermal Insulation, 24 kg/m³ (1½ lb./ft.³) density, 40 mm (1½") thick, with a factory applied vapour barrier facing. Acceptable products are:

.1 Knauf Fiber Glass Blanket Insulation with multi-purpose "FSK" facing

.2 Manson Insulation Inc. "ALLEY WRAP FSK"

.3 Johns Manville Inc. Duct Wrap Type 150 "Microlite"

.4 Isofab Faced Flexible FSK Insulation

.4 **Premoulded Calcium Silicate:** Rigid block and sheet insulation in accordance with requirements of ASTM C533, Structural Insulating Board, Calcium Silicate. Acceptable products are:

.1 Johns Manville Inc. "Thermo-12 Gold"

.2 Industrial Insulation Group "Thermo-12 Gold"

.5 **Flexible Foam Elastomeric Sheet:** Sheet form, CFC free, closed cell, self-adhering elastomeric EDPM rubber insulation in accordance with requirements ASTM C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form, with all required installation accessories.

.1 Armacell "AP/Armaflex SA"

.2 Aeroflex “Aerocel Sheet”

2.7 Equipment Insulation Materials

.1 **BCICA Standard 1503, Type A1D, Semi-Rigid Mineral Fibre:** Blanket type roll form insulation to ASTM Standard C553, Standard Specification for Mineral Fibre Blanket Thermal Insulation, 24 kg/m³ (1½ lb./ft.³) density, with a factory applied vapour barrier facing.

.1 Knauf Fiber Glass Blanket Insulation with multi-purpose "FSK" facing

.2 Manson Insulation Inc. "ALLEY WRAP FSK"

.3 Johns Manville Inc. Type 150 "Microlite"

.4 Isofab Faced Flexible FSK Insulation

.2 **BCICA Standard 1503, Type A1D, Semi-Rigid Mineral Fibre:** Roll form, moulded insulation to ASTM Standard C1393, Standard Specification for Perpendicularly Oriented Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper.

.1 Knauf Fiber Glass Pipe and Tank Insulation

.2 Manson Insulation Inc. "AK FLEX"

.3 Johns Manville Inc. Pipe and Tank Insulation

.4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF"

.5 Owens Corning Pipe and Tank Insulation

.6 Glass-Cell Fabricators Ltd. "R-Flex"

.3 **Semi-Rigid Mineral Wool Blanket:** Equal to Roxul "Enerwrap80" flexible, black fibrous scrim faced mineral fibre blanket insulation to ASTM C 553, Standard Specification for Mineral Fibre Blanket Thermal Insulation.

.4 **Closed Cell Foamed Glass:** Pittsburgh Corning "FOAMGLAS" expanded, rigid board and block type insulation in accordance with requirements of ASTM C552, Standard Specification for Cellular Glass Thermal Insulation, and equipped with a factory applied facing with a liquid or vapour permeability rating of 0.00 as per ASTM C240, Standard Test Method of Testing Cellular Glass Insulation Blocks.

2.8 Insulating Coatings

.1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:

.1 Anti-condensation coating, "No Sweat-FX".

.2 Thermal insulating coating, "thermalite".

2.9 Insulation Fastenings

.1 **Wire:** Minimum #15 gauge galvanized annealed wire.

.2 **Wire Mesh:** Minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.

.3 **Aluminium Banding:** Equal to Childers Products Co. "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.

.4 **Stainless Steel Banding:** Equal to Childers Products Co. "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.

.5 **Duct Insulation Fasteners:** Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1½") square zinc plated steel self-locking washers.

.6 **Tape Sealant:** Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.

.7 **Adhesive - Mineral Fibre Insulation:** Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, WHMIS classified as non-hazardous,

.8 **Adhesive – Flexible Elastomeric Insulation**: Armacell “Armaflex” #520 air-drying contact adhesive.

.9 **Adhesive – Closed Cell Foamed Glass Insulation:** Equal to Pittsburgh Corning PC88 multi-purpose two-component adhesive.

.10 **Lagging Adhesive:** White, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.

.11 **Sheet Metal Screws:** No. 10 stainless steel sheet metal screws.

2.10 Insulation Jackets and Finishes

.1 **BCICA Type D1, PVC:** Roll form sheet and fitting covers in accordance with ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, minimum 15 mil thick, white, PVC, 25/50 rated, complete with installation and sealing accessories. Do not use screws or tacks that will compromise vapor seal under covers.

.1 Proto Corp. "LoSMOKE"

.2 The Sure-Fit System "SMOKE-LESS 25/50"

.3 Johns Manville Inc. "Zeston" 300

.2 **BCICA Type D2, Rigid Aluminium:** Equal to Childers Metals "Lock-on" 0.406 mm (5/32") thick embossed aluminum jacket material to ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, and "Fabstraps" and butt straps to cover end to end joints. Fittings are to be 2-piece epoxy coated pressed aluminum with weather locking edges. Do not use screws or tacks that will compromise vapor seal under covers.

.3 **Protective Coating - Foamed Glass Insulation:** Pittsburgh Corning "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified

.4 **Protective Coating - Flexible Foam Elastomeric Insulation:** Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

.5 **Insulation Cement:** Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, Thermal Insulating and Finishing Cement, and suitable in all respects for the application.

2.11 Removable/Reusable Insulation Covers

.1 **Valve, Etc. Covers:** “No Sweat Valve Wrap Inc.” “NO SWEAT” reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to the adjoining insulation.

.2 Do not use screws or tacks that will compromise vapor seal under covers.

.3 **Equipment Covers:** Custom manufactured covers conforming to the shape of the item to be insulated, designed to be easily removable and replaceable to suit the use and maintenance procedures of the particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m³ (6 lb./ft.³) density ceramic fibre insulation sewn between minimum 542.5 g/m² (1.8 oz./ft.²) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place.

.1 Cossby Dewar Inc.

.2 Insufab Systems Inc.

.3 ADL Insulflex Inc.

.4 Firwin Corp.

.4 Do not use screws or tacks that will compromise vapor seal under covers.

2.12 Duct Lining

.1 Minimum 25 mm (1") thick acoustic lining material meeting NFPA 90A requirements, and flame spread and smoke developed fire hazard ratings of CAN/ULC-S102, flexible, consisting of NBR/PVC based closed-cell, flexible elastomeric foam thermal and acoustic insulation. UL Greenguard gold-certified for low VOC emissions. K-Flex Duct Liner Gray or equivalent.

.1 Where shown on drawings.

2.13 Firestopping

.1 Refer to Section 20 05 60 – Firestopping and Smoke Seal Systems

3 EXECUTION

3.1 General Insulation Application Requirements

.1 Unless otherwise specified, do not insulate the following:

.1 Factory insulated equipment and piping.

.2 Branch domestic water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories.

.3 Exposed chrome plated domestic water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories.

.4 Domestic water and heating system expansion tanks.

.5 Manufactured expansion joints and flexible connections.

.6 Acoustically lined ductwork and/or equipment.

.7 Flexible branch ductwork from sheet metal ducts to grilles or diffusers.

.8 Domestic hot and tempered water and heating system piping unions, except for steam and condensate piping.

.2 Do not apply insulation unless leakage tests have been satisfactorily completed.

.3 Ensure that all surfaces to be insulated are clean and dry.

.4 Ensure that the ambient temperature is minimum 13° C (55° F) for at least one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.

.5 All insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from the site and replaced. Repair damaged insulation jackets.

.6 Install insulation directly over pipes and ducts and not over hangers and supports.

.7 Install piping insulation and jacket continuous through pipe openings and sleeves.

.8 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.9 When insulating "cold" piping and equipment, extend insulation up valve bodies, temperature gauges, shut-off valves and other such projections as far as possible, and protect the insulation jacketing from the action of condensation at its junction with the metal.

.10 When insulating vertical piping risers 75 mm (3”) diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m (15’) centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

.11 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover the exposed end of the insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping, or with barrier mastic.

.12 Insulation thickness must be maintained even where there is interference between weld bead, mechanical joints, etc. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

.13 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in the insulation and provide a suitable grommet in the opening.

.14 Where piping and/or equipment is traced with electric heating cable, ensure that the cable has been successfully tested prior to the application of insulation, and ensure that the cable is not damaged or displaced during the application of insulation. Insulation for electric heat traced systems shall be sized to allow for the presence of heater cable.

.15 Insulate, vapour seal, and finish all seismic restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of the adjacent pipe or equipment finish, to match the piping and/or equipment insulation.

.16 Where existing insulation work is damaged as a result of a new mechanical work, repair the damaged insulation work to new work standards.

3.2 Insulation for Pipe Mechanical Joint Fittings & Couplings, etc.

.1 Provide manufactured insulation fittings, the same thickness as the adjoining pipe insulation, for mechanical joint fittings and couplings, and for piping at riser clamps through the floor. Cover with purpose made full thickness PVC covers with joints sealed with tape.

3.3 Insulation for Horizontal Pipe at Hangers and Supports

.1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply the insulation sections to the piping installers for installation as the pipe is erected.

.2 For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to the pipe at each roller hanger or support location. Pack saddle voids with loose mineral fibre insulation.

.3 Coordinate the pre-insulated pipe supports with the mechanical contractor.

3.4 Valve Stem Extensions

.1 Valve stem extensions are required where valve operation will damage or come in contact with the vapor and mechanical insulation jacket.

3.5 Pipe Insulation Requirements – Above Ground Inside and Outside the Building

.1 Insulate pipe inside the building and above ground, as scheduled below, in accordance with BCICA Quality Standard 1501, Piping, as follows:

.1 **Material:** Type A2 mineral fibre.

.2 **Insulation application:**

.1 1501-H for hot piping.

.2 1501-C for cold piping.

.3 **Exposed Insulation finish:**

Exposed Mechanical Rooms - PF2 Premium 2

.1 Over the pipe insulation apply a layer of sheathing paper adequately stapled in place, then apply treated fabric jacket with fabric adhesive.

.2 Alternately, a factory applied integral all-service type jacket on the pipe insulation may be used as the sheathing paper. The factory-applied jacket shall be neatly applied to receive the treated fabric jacket. Over insulated surface, apply treated canvas jacket as per manufacturer's recommendations.

.3 Over insulated fittings, apply PVC fitting covers. Over insulated valve bodies, valve bonnets, strainers and flanges apply treated fabric jacket as per manufacturer's recommendations. Alternatively, commercially available PVC covers may be used.

.4 Finish fabric with one (1) coat of fabric coating imbedded into fabric.

Exposed Inside the Building – PF5 PVC Jacket

.5 Over the pipe insulation, apply PVC jacket using necessary fastenings on approximately 100mm centre. Alternatively, SSL (self-seal lap) or solvent weld seams are acceptable. Tacks will not be used where a continuous vapour barrier is required.

.6 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges, apply PVC jacket or pre-formed PVC fitting covers to provide a complete jacket system. Secure with necessary fastening and jacket finishing tape.

Concealed Inside the Building – PF3 Economy

.7 Apply pipe covering with integral vapour barrier jacket to piping and hold in place by securing the jacket flap. Seal all flaps and butt strips with vapour barrier adhesive. Pipe covering with integral self-sealing vapour barrier jacket will not require additional fastening.

.8 Over insulated fittings, apply PVC cover. Over insulated valve bodies, valve bonnets, strainers and flanges, apply all service jacketing (ASJ) using necessary fastenings and jacket finishing tape, or alternatively use PVC fitting covers.

Exposed Outside the Building – PF4 Metal Jacket

.9 Over the pipe insulation, apply aluminum metal jacket using necessary fastenings at minimum 150mm centres including refrigerant piping.

.10 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges, apply metal jacket or preformed metal fittings to provide a complete metal jacket system. Secure with necessary fastenings.

Note:

- The use of PVC jacketing or fitting covers is limited by the Building Code or by-law requirements for smoke/flame developed classification.
- Where continuous vapour barrier is required, the use of penetrating type fasteners will be avoided and id required, such fasteners shall be sealed to maintain the vapour barrier performance.

COLD PIPE INSULATION									
System	**Class**	**Insulation Material**	**Operating Temperature**	**Insulation Thickness**					
				Runouts (4m/13ft Max)	**Less than 25mm (1")**	**25mm (1") to 32mm (1-1/4")**	**38mm (1-1/2") to 75mm (3")**	**100mm (4") to 200mm (8")**	**Greater than 200mm (8")**
Condensate Drain (From Cooling Systems)	A2	Mineral Fibre c/w Vapour Seal	-	12mm (1/2")	25mm (1")	25mm (1")	25mm (1")	25mm (1")	25mm (1")
Domestic & Non-Potable Cold Water	A2	Mineral Fibre c/w Vapour Seal	<15.6C (<60F)	25mm (1")	25mm (1")	25mm (1")	25mm (1")	25mm (1")	25mm (1")
Drainage Vent (Min 3m/10ft From Roof Penetration)	A2	Mineral Fibre c/w Vapour Seal	-	-	-	-	25mm (1")	25mm (1")	25mm (1")
Storm Drains	A2	Mineral Fibre c/w Vapour Seal	-	-	-	25mm (1")	25mm (1")	25mm (1")	25mm (1")

HOT PIPE INSULATION									
System	**Class**	**Insulation Material**	**Operating Temperature**	**Insulation Thickness**					
				Runouts (4m/13ft Max)	**Less than 25mm (1")**	**25mm (1") to 32mm (1-1/4")**	**38mm (1-1/2") to 75mm (3")**	**100mm (4") to 200mm (8")**	**Greater than 200mm (8")**
Domestic Hot Water & Non-Potable Hot Water & Hot Water Recirculation	A2	Mineral Fibre	60.6C-93.3C (141F-200F)	25mm (1")	38mm (1-1/2")	38mm (1-1/2")	50mm (2")	50mm (2")	50mm (2")
Domestic Hot Water & Non-Potable Hot Water & Hot Water Recirculation	A2	Mineral Fibre	43.9C-60.6C (111F-140F)	25mm (1")	25mm (1")	25mm (1")	38mm (1-1/2")	38mm (1-1/2")	38mm (1-1/2")
Domestic Hot Water & Non-Potable Hot Water & Hot Water Recirculation & Tempered Water	A2	Mineral Fibre	<43.9C (<111F)	25mm (1")	25mm (1")	25mm (1")	38mm (1-1/2")	38mm (1-1/2")	38mm (1-1/2")
Sanitary Traps (Barrier Free Lavatories)	A2	Closed Cell Vinyl	-	-	-	12mm (1/2")	12mm (1/2")	-	-

Notes:

1. Insulate storm drainage piping from roof drains including drain bodies, from the roof drain to the to the lowest aboveground point where the piping connects to a below grade horizontal main.
2. BCICA Standard 1501 Type A6 insulation may be used in lieu of Type A2, with Type 1501-AA /CA application.
3. Use non-combustible rock slag mineral fiber insulation for insulated pipe penetrating through fire rated construction, and for high temperature piping insulation such as high pressure steam and condensate.
4. BCICA Standard 1501, Type A5 insulation with 1501-CA application may be used in lieu of mineral fibre insulation.

3.6 Ductwork System Insulation Requirements – Inside Building

.1 Insulate duct systems inside the building and above ground, as scheduled below, in accordance with BCICA Quality Standard 1502, Ductwork and Plenums, as follows:

.1 **Material:**

.1 Type A2 rigid mineral fibre for exposed rectangular ducts, and all plenums.

.2 Type B2 flexible mineral fibre for concealed rectangular ducts, and concealed and exposed round or oval ducts.

.2 **Insulation application:**

.1 ER/1 for heating and ventilating system rigid insulation.

.2 ER/2 for heating and air conditioning system rigid insulation.

.3 EF/1 for heating and ventilation system flexible insulation.

.4 EF/2 for heating and air conditioning system flexible insulation.

.3 **Insulation finish:** RF/3 for exposed duct systems.

DUCT SYSTEM SERVICE	**INSULATION THICKNESS**	
	Rigid Insulation	**Flexible Insulation**
Fresh (outside) air ducts	38 mm (1-1/2”)	50 mm (2”)
Fresh (outside) air casings and plenums	38 mm (1-1/2”)	N/A
Mixed air casings and plenums	25 mm (1”)	N/A
Mixed air supply ducts (except where exposed in area served)	25 mm (1”)	38 mm (1-1/2”)
3 m of exhaust discharge ducts downstream (back) from exhaust openings to atmosphere	25 mm (1”)	38 mm (1-1/2”)
Exhaust air casings and plenums within 3 m of exhaust openings to atmosphere	25 mm (1”)	N/A

Notes:

1. Provide commercial quality corner bead on rigid duct, plenum, and casing insulation in all equipment rooms where the insulation is subject to damage.

3.7 Duct System Insulation Requirements – Outside Building

.1 Insulate all exposed exterior ductwork (i.e. exhaust air duct) and any associated casings and plenums (except fresh air intake systems) outside the building and above ground, with 50 mm (2”) thick flexible foam elastomeric sheet insulation applied in 2 layers with staggered tightly butted joints and secured in place with adhesive in strict accordance with

the insulation manufacturer's instructions. Ensure that sheet metal joints are sealed water-tight prior to the insulation application.

3.8 Common Duct System Insulation Requirements: Insulation application requirements common to all types of rigid ductwork are as follows:

.1 At duct connection flanges insulate the flanges with neatly cut strips of the rigid insulation material secured with adhesive to side surfaces of the flange with a top strip to cover the exposed edges of the side strips, then butt the flat surface duct insulation up tight to the flange insulation, or alternatively, increase the insulation thickness to the depth of the flange and cover the top of the flanges with tape sealant.

.2 The installation of fastener pins and washers shall be concurrent with the duct insulation application.

.3 Cut insulation fastener pins almost flush to the washer and cover with neatly cut pieces of tape sealant.

.4 Accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers.

.5 Prior to concealment of insulation by either construction finishes or canvas jacket material, patch all vapour barrier damage by mans of tape sealant.

3.9 Equipment Insulation Requirements – Inside Building

.1 Insulate equipment inside the building the building, as scheduled below, in accordance with BCICA Quality Standard 1503, Equipment, as follows:

.1 **Material:** Type A1D semi-rigid mineral fibre.

.2 **Insulation application:**

.1 1503-H for hot tanks and equipment.

.2 1503-C for cold tanks and equipment.

.3 **Insulation finish:**

.1 EF/2 for hot tanks and equipment.

.2 CF/2 for cold tanks and equipment.

3.10 Equipment Insulation Requirements – Removable/Reusable Type

.1 Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items, and for steam traps and similar items requiring service in piping less than 150 mm (6") diameter.

3.11 Application of Insulating and Protective Coatings

.1 Apply insulating and protective coatings in accordance with the manufacturer's instructions. Remove any splatter from adjacent surfaces. Apply insulating/protective coating to the following surfaces:

.1 Paint all bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of the pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating.

.2 Paint all bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "thermalite" insulating coating.

.3 Paint all seismic restraint hardware such as hanger rods, braces, anchors, etc., as specified on .1 and .2 above

.4 Coat elastomeric foamed insulation (pipe & duct) with 1 coat of the specified coating on all insulation inside the building and 2 coats (with 24 hours between coats) of the specified coating on all insulation outside the building.

3.12 Chilled & Cold Water Pipe Insulation Vapour Damage Protection

.1 Ensure that all pipe insulation longitudinal and circumferential joints are properly sealed.

.2 Ensure that there are no perforations to insulation vapour barriers.

.3 Provide properly sealed vapour dams in locations as follows:

.1 On butt ends at all locations where the insulation terminates

.2 On butt ends and other exposed insulation surface on either side of fittings, tees, flanges, couplings, valves, strainers, and similar pipe accessories, with the exception of cluster piping (every 75mm)

.3 Butt ends at every 3rd section of insulation (maximum 6 m (20') intervals) on horizontal piping

.4 On butt ends at every 2nd section of insulation (maximum 2.4 m (8') intervals) in vertical piping

3.13 Valves

.1 Provide valve stem extensions as required to enable insulation of valve stems. Insulate void space around valve fittings. Valves to be fully operational without compromising the insulation integrity.

3.14 Insulation Finish Requirements

.1 **White PVC:** Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Linear overlaps to have a factory installed self-seal tape. Seal all joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions. Do not use tacks or staples on piping systems requiring a vapor barrier.

.2 **Rigid Aluminum:** Install aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide aluminum jacket for the following insulation:

.1 All outdoor insulated piping.

.2 All outdoor ductwork.

.3 **Protective Coating - Foamed Glass Insulation:** Apply 2 heavy coats of "PITTCOTE 404" coating with 24 hours between coats to all foamed glass insulation exposed above grade.

.4 **Protective Coating – Flexible Elastomeric Insulation:** Apply 1 coat of the specified coating to all insulation inside the building. Apply 2 coats (with 24 hours between coats) of the specified coating to all insulation outside the building.

3.15 Installation of Barrier Free Lavatory/ Sink Insulation Kits

.1 Provide manufactured insulation kits to cover exposed drainage and water piping under new barrier free lavatories/sinks.

3.16 Installation of Duct Lining

.1 Provide acoustic lining in ductwork in locations as follows:

.1 Wherever shown and/or specified on the drawings.

.2 Supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along the duct and outward from the box in all directions.

.2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel as per the detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.17 Insulation of Seismic Restraint Hardware:

.1 Insulate all seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from the piping or equipment with insulation and finish to match the pipe or equipment insulation. Coat all seismic restraint hardware for a distance of 300 mm (12") from the termination of the insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

End of Section

1 GENERAL

1.1 Application

.1 This Section specifies variable frequency drive requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Submittals

.1 **Product Data:** Submit product data sheets for variable frequency drives. Include all construction and performance details with the submission, as well as wiring and control schematics, and dimensions.

.2 **Certification Letter:** Submit a start-up and installation certification letter from the supplier of the variable frequency drives as specified in Part 3 of this Section.

1.3 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Variable Frequency Drives

.1 Factory assembled and tested, CSA or ETL certified, fully digital, pulse width modulated type VFD’s, each matched to the motor it is associated with and each suitable for operation in an ambient temperature range of between -10°C and 40°C (15°F and 105°F) with a maximum humidity of 95% non-condensing, and a maximum altitude of 100 m (3300') for rated output. No transformers are to be used in either the input or output of the VFD.

.2 **Operation:** Each VFD shall operate as follows:

.1 If the "Manual" mode is selected the VFD/motor is to start when the run key is depressed and the speed shall be controlled by depressing the Accelerate or Decelerate keys on the keypad, or by the direct speed set mode.

.2 If the "Auto" mode is selected the VFD/motor is to start when a contact closure run command is received from the building control system, and the speed shall be controlled by a speed reference signal from the building control system.

.3 In the event of a power outage the VFD is to automatically restart when the power returns provided the run command is maintained.

.4 In the event of an inverter fault trip, the VFD is to attempt to restart automatically up to maximum of five attempts and, if after five attempts, restart does not occur, the VFD is to lock out.

.3 **Performance:** Each VFD shall have performance characteristics as follows:

.1 Minimum efficiency of 97% at maximum load and speed.

.2 Minimum line side displacement power factor of 0.96 at all speeds and loads.

.3 Adjustable minimum and maximum motor frequency of 0 to 120 Hz.

.4 Separately adjustable acceleration and deceleration ramps from 0.1 to 3,600 seconds with damping and smoothing parameters for 0% to 100% speed.

.5 DC injection braking.

.6 Automatic restart after an inverter fault trip, and the VFD is to attempt to restart automatically five times with lock-out after the fifth attempt if a restart has not occurred.

.7 The VFD is to restart the motor at the speed at which it is rotating and then re-accelerate to the speed called for by the speed reference signal.

.8 Capable of running for setup and testing without a motor connected.

.9 Auto restart after power outage.

.10 Skip frequency reject point to prevent the motorized equipment from operating at a resonant speed, and adjustable centre frequency with a band width of 0-10 Hz.

.11 Automatic/manual signal follower for 4-20 ma, 0-20ma, 0-10 VDC or 2-10 VDC reference.

.12 Capable of accepting AC line voltage variations of +10% to –15%.

.4 **Design and Construction Features:** Each VFD, as a minimum, shall be complete with:

.1 External 5% DC Swing Choke input reactor capable of maintaining impedance thru entire speed range. to reduce the total harmonic distortion. 575 volt applications to include 3% output load reactors to limit the dv/dt to 1500 volts / 0.5 microseconds at motor terminals.

.2 Soft switching insulated gate bipolar transistors in the inverter section.

.3 NEMA12, sprinkler-proof metal enclosure with hinged door.

.4 A horsepower rated, door interlocked, pad-lockable fused main disconnect switch.

.5 Input line fuses coordinated with electronic protection circuits so as not to blow under normal output faults such as overcurrent, short circuit, and ground fault, and three spare fuses in a holder on the back of the enclosure door.

.6 Protective devices consisting of, as a minimum:

.1 Line over voltage and line under voltage protection.

.2 Phase loss and unbalance protection.

.3 Short circuit protection for line to line and line to ground faults.

.4 Electronic instantaneous overcurrent protection.

.5 Current limit, adjustable between 25% and 120%.

.6 A continuous duty service factor of 100% rated output current with I^2t overload protection rating of 120% for 1 minute.

.7 Internal over temperature protection.

.8 Electronic motor stall protection to trip the VFD off should a motor overload or stall occur.

.7 Operate interface facilities consisting of a door mounted keypad with a 32 character Alpha-numeric high resolution display to allow personnel to set up and monitor the VFD parameters, observe output speed, load or other programmable values, and monitor status and fault information, complete with tactile keys and backlit display, and the following:

.1 Maintenance monitoring to display the time since starting, total elapsed run time, and total KWH, and maintenance target alarm to alert the operator with a displayed message.

.2 The following control functions on the door mounted keypad, as follows:

.1 Run (Hand and Auto Mode).

.2 Stop (Hand and Auto Mode).

.3 Parameterization button (to toggle between parameters).

.3 A selectable display to observe the following parameters:

.1 Frequency.

.2 Frequency set-point.

.3 Motor current.

.4 DC-link voltage.

.5 Motor torque (% nominal).

.6 Motor RPM.

.4 Fault diagnostics to simplify troubleshooting, and, in the event of a fault condition, the display it so indicate the nature of the fault, including:

.1 Overvoltage.

.2 Undervoltage.

.3 Overcurrent.

.4 Overload.

.5 Overheating of motor (monitoring with PTC).

.6 Inverter over temperature.

.7 Main phase missing (for 3 phase units).

.8 Control system interface facilities, consisting of:

.1 Dry contact closure from the control system for run command (Auto Mode).

.2 4-20 mA (0-20 mA, 0-10 VDC, 2-10 VDC) signal from the control system for speed control (Auto Mode).

.3 Dry contact (N.O.) output to the control system to indicate:

.1 Inverter fault.

.2 Inverter running.

.4 0-20 mA or 4-20 mA analog output to the control system, proportional to 0-100% speed or load.

.5 6 programmable digital inputs, 3 programmable output, relays, 2 analog inputs, 2 programmable 4-20ma analog outputs, 2 PID loops, RS485 w- BACnet, N2 Metasys and Modbus RTU protocols.

.9 Modular components and circuitry necessary to safely bypass the motor from the VFD to line, or from the line to the VFD at zero speed, and consisting of:

.1 Mechanically interlocked contactors on the output of the VFD and in the bypass circuit.

.2 An inverter/bypass selector switch with indicator lights for each mode of operation, located in the enclosure door when specified on schedule.

3 EXECUTION

3.1 Supply of Variable Frequency Drives

.1 Supply variable frequency drives for motorized mechanical equipment in accordance with drawing requirements.

.2 Ensure that all variable speed drives are the products of the same manufacturer.

.3 Where VFD’s are required for custom made air handling units the VFD’s will be supplied, factory mounted on fan cabinets, and "load" side connected to fan motors by the air handling unit manufacturer. "Line" side power wiring to these VFD’s will be done as part of the electrical work.

.4 Where VFD’s are required for commercial fans, mount each VFD generally where shown but with exact location to ensure that the VFD is accessible in accordance with Electrical Code requirements. "Line" and "load" side power wiring to these VFD’s will be done as part of the electrical work.

.5 Where VFD’s are required for pumps, mount each VFD generally where shown but with exact location to ensure that the VFD is accessible in accordance with Electrical Code requirements. "Line" and "load" side power wiring to these VFD’s will be done as part of the electrical work.

.6 When installation of the VFD’s is complete, arrange for the VFD manufacturer/supplier to:

.1 Supply a factory authorized technician at the site for a minimum of 4 hours per system to examine installation and connection of each VFD, and to perform start-up and set-up procedures in conjunction with equipment start-up and testing procedures.

.2 Supply a factory authorized technician at the site for a minimum of one 8 hour day to train the Owner’s personnel on VFD operating and maintenance procedures.

.3 Prepare and submit a letter to certify that all VFD’s have been properly installed, tested and adjusted, and are in proper operating condition.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies requirements for supply of motor starters, motor control centres, and mechanical wiring for mechanical work that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Submittals

.1 **Product Data:** Submit product data sheets for all products specified in this Section except conduit, wiring and accessories. Include all construction and performance details with the submission, as well as wiring and control schematics.

.2 **Switch Keys:** Submit three identified keys for each key operated manual motor starting switch.

1.3 Quality Assurance

.1 Motor starters shall be accordance with the following standards:
- **.1** CSA-C22.2 N0. 14, Industrial Control Equipment**.**
- **.2** Tri-National Standard CAN/CSA-60947-4-1/UL 60947-1A/NMX-J-Z90-ANCE, Low Voltage Switchgear and Controlgear-Part 4-1: Contactors and Motor Starters-Electromechanical Contactors and Motor Starters**.**

.2 Motor control centres are to be in accordance with requirements of CSA-C22.2-No. 254, Motor Control Centres.

.3 Base Bid and Acceptable Manufacturers:
- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Motor Starters

.1 **General:** General requirements for motor starters are as follows:
- .1 All motor starters must be capable of starting the associated motors under the imposed loads.
- .2 Confirm that starter voltage matches the motor prior to ordering.
- .3 Unless otherwise specified, all motor starters (and disconnect switches) are to have a 50,000 symmetrical SCIA (short circuit interrupting ampacity).
- .4 Equip starters with accessories and modifications as per the drawing motor starter schedule.
- .5 Equip every starter associated with a building fire alarm system fan shutdown with a double voltage relay with suitable coil voltage.
- .6 Each starter that controls a motor with thermistor protection shall be equipped with a latching relay which controls a blue neon pilot light upon activation of the thermistor and an auxiliary contact installed in series with the overloads, and a reset button to reset the latching relay.

.2 **Single Phase Motor Starters:** Unless otherwise specified or scheduled single phase motor starters are to be manual motor starting switches, each suitable in all respects for the motor it controls and complete with a neon “ON” pilot light, a snap action toggle operator designed to prevent the switch from being held closed under a sustained motor overload, an enclosure to suit the application, and properly sized thermal overload protection which can be reset by moving the toggle to the “OFF” position.

.3 **Starters for Three Phase Motors Less Than 25 HP:** Unless otherwise specified, starters for three phase motors less than 25 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with a properly sized thermal overload relay per phase, a 120 volt holding coil, and an enclosure to suit the application.

.4 **Motor Starter Enclosures:** Unless otherwise specified, motor starter enclosures are to be in accordance with the following NEMA/EEMAC ratings:
- .1 All enclosures located in sprinklered areas – Type 2.
- .2 All enclosures exposed to the elements – Type 3R, constructed of stainless steel.
- .3 All enclosures inside the building in wet areas – Type 3R, constructed of stainless steel.
- .4 All enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application.
- .5 All enclosures except as noted above – Type 1.
- .6 All enclosures located in finished areas – as above but recess type with #4 brushed finish stainless steel faceplate.

2.2 Motor Control Centres

.1 Multi-unit, modular, 2.4 m (8') high overall, minimum 300 mm (12”) high modules, EEMAC Class II, type "B", factory assembled, dead front, floor mounting, free-standing, front accessible motor control centre(s) as per drawing schedule and details, each capable of operating continuously in a 40º C (105º F) ambient temperature and complete with accessible horizontal and vertical tin plated copper bus including ground bus with grounding lugs, wiring gutter barriered from bus compartments, blank spaces with hinged covers and full bussing where indicated, and an EEMAC Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre exterior shall be finished with ASA 61 grey enamel and each interior shall be finished with white enamel. Each motor control centre shall be equipped with starters as specified above, load and barriered control wiring terminal boards, and all required facilities for line and load side power wiring connections.

.2 The external operating handle of each disconnecting device shall be identified with “ON” and “OFF” indication, and each handle shall be interlocked with the module door such that the handle must be in the “OFF” position before the door can be opened.

2.3 Disconnect Switches for Motor Control Centres

.1 Heavy-duty, CSA certified, front operated switches as per the motor starter schedule, each complete with a handle suitable for padlocking in the "off" position and arranged so that the door cannot be opened with the handle in the "on" position and an EEMAC enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.

2.4 Fuses

.1 **Fuses:** Unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "j" for constant running equipment and Form II Class "C" for equipment that cycles on and off.

2.5 Motor Starter Panels

.1 Level #14 gauge G60 galvanized sheet steel panel with rolled edges, sized to suit the number of starters/disconnect switches to be mounted plus 20% blank space, secured to a galvanized steel angle framework suitable for wall mounting and equipped with a suitable length of splitter trough to feed the starters/disconnects.

2.6 Warning Signs

.1 Appropriately sized white PVC warning signs with red lettering, screw holes, and stainless steel screws.

3 EXECUTION

3.1 Supply of Motor Starters and Accessories

.1 Unless otherwise shown or specified, supply a starter for each item of motorized equipment you provide. Refer to the drawing Motor Starter Schedule.

.2 **Three Phase Motor Starters in Motor Control Centres:** Where three phase starters are indicated in motor control centres, supply the motor control centres with starters and bolt, level and plumb, to a concrete housekeeping pad where shown.

.3 **Disconnect Switches in Motor Control Centres:** Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with the equipment is fed from a motor control centre, provide a disconnect switch in the motor control centre in lieu of a motor starter.

.4 **Three Phase Motor Starters on Motor Starter Panels:** Where three phase starters are indicated and/or scheduled to be mounted on a motor starter panel, provide the panel(s). The starters will be mounted and connected, complete with the panels and splitter trough, as part of the electrical work. Hand the starters to the electrical trade at the site when they are required.

.5 **Disconnect Switches on Motor Starter Panels:** Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with the equipment is fed from a motor starter panel, a disconnect switch will be provided on the motor starter panel as part of the electrical work

.6 **Single Phase Motor Starters:** Unless otherwise specified or shown on the drawings, single phase motor starters will be mounted adjacent to the equipment they serve and connected complete as part of the electrical work. Hand the starters to the electrical trade at the site at the proper time.

.7 **Warning Signs:** Provide warning signs at starter locations where required, i.e. “Motor is Under Automatic Control and May Start at Any Time without Warning”.

3.2 Electrical Wiring Work for Mechanical Work

.1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment will be done as part of the electrical work:
- .1 "Line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment.
- .2 "Line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment.
- .3 "Line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment.
- .4 Provision of receptacles for plug-in equipment.
- .5 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring.
- .6 All motor starter interlocking in excess of 24 volts.
- .7 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts.
- .8 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work.
- .9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers.
- .10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units.
- .11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.

.2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work shall be installed in conduit and shall be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

3.3 Installation of Motor Control Centres

.1 Provide motor control centres where shown.

.2 Secure each MCC in place on a concrete housekeeping pad.

.3 Ensure that the electrical trade connecting the MCC's tightens all accessible bus connections using a torque wrench in accordance with the MCC manufacturer's instructions, and does all "load" and "line" side wiring.

.4 Ensure that all motor starter interlocking work is performed in accordance with Contract Document control diagrams and sequences.

.5 Supply a complete set of spare identified fuses for each fuse protected device and store in an identified wall mounted steel cabinet within the Electrical Room.

.6 If MMC and component identification is not factory installed, install at the site using stainless steel screws.

.7 Coordinate building automation system connections to MCC hardware with the mechanical trade doing the building automation system work. Assist as required during testing and commissioning of the BAS.

.8 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.

.9 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.10 **Commissioning:** Commission equipment after successful start-up and submittal of reports.

.11 **Demonstration and Training:** Refer to the article entitled Equipment and System O&M Demonstration & Training in the Mechanical Work General Instructions Section. Include for one 4 hour day of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies requirements, criteria, methods, and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and shall be read accordingly.

1.2 Submittals

.1 Submit documentation to confirm that reclaimed refrigerant has been properly removed and stored, recycled, or disposed of as applicable.

1.3 Reference Standard

.1 Perform demolition work in accordance with requirements of CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 Disconnection and Removal of Existing Mechanical Work

.1 Where indicated on the drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, and similar items. Disconnect at the point of supply, remove obsolete connecting services, and make the system safe. Cut back obsolete piping behind finishes, identify, and cap water-tight unless otherwise specified.

.2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent, and cost of the work at the site during the bidding period scheduled site visit(s).

.3 Where concealed conditions differ from those indicated on the drawings, immediately notify the Consultant.

.4 Where utilities are removed, relocated, or abandoned, cap, valve, plug, or by-pass to produce a complete and working installation.

.5 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.

.6 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.

.7 If existing isolation valves are not available to isolate sections of piping to be removed, provide such valves as required. Determine this requirement at the site during the bidding period.

.8 Where existing valves are removed, remove the valve tags, revise existing valve tag charts, and hand the obsolete tags to the Owner.

.9 If any re-design is required due to discrepancies between the mechanical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the mechanical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.

.10 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.

.11 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.

.12 When existing DDC controls devices are being removed such as valves or sensors, update the DDC graphics to accurately reflect the changes. Notify the controls contractor of any control devices removed during demolition.

3.2 Hazardous Materials and Waste

.1 Be advised that items such as drainage sumps, catch basins, interceptors, and the like may contain unidentified hazardous waste and caution shall be taken when disconnecting and removing these items.

.2 If hazardous waste not listed in the Specification is found, stop the associated work and notify the Owner and Consultant immediately and await directions.

3.3 Decommissioning or Alterations to Refrigeration Equipment

.1 Remove and reclaim refrigerant from all applicable equipment to be decommissioned and/or altered. All refrigerant reclaim and recycling work shall be in accordance with Refrigerant Management Canada guidelines, and governing codes and regulations. Do not under any circumstances vent refrigerant from existing equipment to atmosphere.

.2 Use refrigerant recovery equipment designed specifically to reclaim and recycle refrigerant, and use only skilled refrigeration mechanics to perform the reclaim and recycle work.

.3 Provide approved, properly sized, and sealable refrigerant containers for reclaimed refrigerant.

.4 Hand the containers of refrigerant to the Owner at the site.

.5 Dispose of reclaimed refrigerant by engaging the services of a licensed firm specializing in recycling of reclaimed refrigerant. Submit documentation to confirm that the refrigerant has been properly removed from the site and recycled or disposed of.

3.4 Roofing Work

.1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing mechanical equipment on the roof as required to permit completion of the roofing work, and for re-installing the equipment when the roofing work is complete.

3.5 Making Good

.1 Where existing building surfaces and finishes are cut or other wise disturbed to permit demolition work, you are responsible for “making good” the existing surfaces and finishes.

.2 “Making good” means providing new surfaces and finishes identical to the surfaces and finishes cut or disturbed with no visible difference between new and existing.

.3 Where painting is required, paint the entire surface between the nearest adjacent corners, i.e. the entire plane surface incorporating the cut or disturbed surface.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies commissioning requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Reference

.1 Refer to commissioning requirements specified in Division 01.

1.3 Commissioning Agent Involvement vs Warranty Obligations

.1 The involvement of the Commissioning Agent performing duties as described in this Section does not in any way void or alter any Contractual warranty obligations.

1.4 Submittals

.1 **Shop Drawings/Product Data Sheets:** Submit to the Commissioning Agent, at the same time as submittal to the Consultant, 1 copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.

.2 **Commissioning Plan, Procedures, Schedule, and Data Sheets:** Submit for review, a Commissioning Plan with schedule, commissioning procedures for all commissioning events, and a copy of the Commissioning Agent's commissioning data sheets for all equipment/systems to be commissioned.

.3 **List of Commissioning Instruments:** Submit a list of commissioning instruments and for each instrument, indicate the purpose of the instrument and include a recent calibration certificate.

.4 **Start-Up and Test Report Sheets:** Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.

.5 **Letters to Certify Readiness for Functional Performance Testing:** After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter to confirm that pre-functional performance testing has been successfully completed and the system or subsystem is ready for functional performance testing and the commissioning process to commence.

1.5 Definitions

.1 The following are definitions of words used in this Section:

- .1 **Commissioning:** the process of demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of the Contract Documents, all as further described below.
- .2 **Commissioning Agent:** the commissioning authority who will supervise the commissioning process, and who will recommend final acceptance of the commissioned mechanical work.
- .3 **Start-Up and Adjusting:** the process of equipment manufacturer's/supplier's technical personnel, with the Contractor, starting and operating equipment and systems, making any required adjustments, documenting the process, and submitting manufacturer's/supplier's start-up reports to confirm that the equipment has been properly installed and is operational as intended, and a pre-requisite to operational performance testing.
- .4 **Operational Performance Testing:** testing, adjusting and operating of components, equipment, systems and/or subsystems, by the Contractor, after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract

Documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.

.5 **Functional Performance Testing:** a repeat of successful operational performance testing by the Contractor, in the presence of the Commissioning Agent and Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.

.6 **Commissioning Documentation Sheets:** prepared sheets for operational performance testing and for functional performance testing supplied by the Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with the Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag as per the drawings, and, for each commissioning procedure listed, a column giving the expected data as per the Contract Documents, a column to fill in the observed data during commissioning, and space for signatures of the Contractor and Commissioning Agent.

.7 **BAS:** building automation system.

.8 **Systems Operating Manual:** a manual prepared by the Commissioning Agent to present an overview of the building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of the systems.

.9 **Validate:** to confirm by examination and witnessing tests the correctness of equipment and system operation.

1.6 Commissioning Agent

.1 Retain the services of a qualified Commissioning Agent.

1.7 Quality Assurance

.1 Commissioning work shall be in accordance with requirements of the following:
- .1 CSA Z8001, Commissioning of Health Care Facilities.
- .2 CSA Standard Z320, Building commissioning.
- .3 ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems.
- .4 ASHRAE Guideline 1.5, Commissioning Smoke Control Systems.

.2 The Commissioning Agent shall meet the following qualifications:
- .1 Be a member of the Professional Engineers Association in the Province of the work.
- .2 Be a member of the Building Commissioning Association, and a Certified Commissioning Professional (CCP) as designated by the Building Commissioning Association.
- .3 Have a minimum of 5 years of successful documented commissioning experience on projects of similar size and complexity as this Project.
- .4 Supply a qualified P. Eng. and a Building Commissioning Association Certified Commissioning Professional (CCP) or an ASHRAE Commissioning Project Management Professional (CPMP) on site to supervise the commissioning process.

1.8 Commissioning Objectives

.1 Objectives of the commissioning process are as follows:
- .1 To support quality management by means of monitoring and checking the installation.
- .2 To verify equipment/system performance by means of commissioning of the completed installation.
- .3 To move the completed equipment/systems from the "static completion" state to the "dynamic" operating state so as to transfer a complete and properly operating installation from the Contractor to the Owner.

1.9 Testing Equipment

.1 The Contractor shall supply all instruments and test equipment required to conduct start-up and testing. The Commissioning Agent shall supply all instruments and test equipment required commissioning procedures.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 Commissioning

.1 Commission the mechanical work in accordance with requirements of this Section of the Specification.

.2 **Prerequisites to Commissioning:** Prerequisites to successful completion of commissioning are as follows:
- .1 Submittal of signed start-up and test reports.
- .2 Completion by the Contractor of system testing, adjusting, and balancing, and acceptance of the TAB reports.
- .3 Permanent electrical and control connections of all equipment.
- .4 Successful completion and documentation of operational performance testing.
- .5 Submittal of letters to the Consultant certifying that the systems and subsystems have been started, tested, adjusted, successfully operationally performance tested, are ready for functional performance testing, and are in accordance with requirements of the Contract Documents.

3.2 Phasing of Commissioning

.1 The Project will be constructed in phases as described in the Specification. Commissioning must be phased to suit the progress and phases of the work.

3.3 Deficiencies Listed During Commissioning

.1 Deficiencies listed by the Consultant and Commissioning Agent during the commissioning process are to be corrected by the Contractor within 10 calendar days unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the Consultant and Commissioning Agent at once.

3.4 Systems to be Commissioned

.1 Mechanical systems to be commissioned include, but are not to be limited to, the systems described below.

.2 **Drainage Systems:** Commissioning of drainage systems shall include:
- .1 Commissioning of all drainage pumps and controls by means of tests recommended by the manufacturer to confirm proper operation and performance.
- .2 Commissioning of all equipment such as interceptors and backwater valves.

.3 **Fire Protection Systems:** Commissioning of fire protection systems will be considered complete upon preparation and submittal by the Contractor of completion certificates required by applicable NFPA Standards, demonstration of proper system operation to the local Fire Chief and any other authorities, including the Owner’s insurance underwriter as required, and coordination and cooperation with fire alarm system commissioning procedures, in particular smoke control systems and other such fan system control sequences.

.4 **Water Systems:** Commissioning of water systems (all piping extended from the Municipal main) shall include:
- .1 Commissioning of piping specialties such as backflow preventers, pressure reducing valves, mixing valves, and similar components.
- .2 Commissioning of plumbing fixtures by successful operation of each fixture.

.5 **Heating Systems:** Commissioning of heating systems shall include all piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during the heating season, a follow-up site visit during the heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.6 **Cooling Systems:** Commissioning of cooling systems shall include all piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.7 **Air Handling Systems:** Commissioning of air handling systems shall include all equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows as per TAB reports.

.8 **Controls:** Control work commissioning shall include confirmation of proper operation of all individual control components, and overall operation of the controls in conjunction with the operation of the connected building systems, including heating season/cooling season testing requirements specified above.

.9 **Building Automation System:** Commissioning of the BAS shall include confirmation of proper operation of all components, all input/output points, all hardware and software, and demonstration of the system performing all required procedures.

.10 **Special Usage Room Controls:** Commissioning of special usage room controls shall include confirmation of proper operation of all individual components, and proper operation of the overall control system, all in accordance with governing Codes and Standards.

.11 **Noise and Vibration Control Systems:** Commissioning of noise and vibration control equipment shall include noise and vibration measurements to confirm proper operation of the equipment.

.12 **Existing Systems:** The following existing systems, revised as part of the mechanical work, are to be commissioned as for new systems:

3.5 Commissioning Process

.1 The commissioning process shall be performed in stages and shall include, but not be limited to, the following:
- .1 **Stage 1:** Commissioning of mechanical equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance and includes supervising and validating results of functional performance testing, and submittal of the reviewed Systems Operating Manual.
- .2 **Stage 2:** Commissioning work to be performed twelve months after issue of a Certificate of Substantial Performance and which includes supervision of the Contractor’s "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.
- .3 **Stage 3:** Successful completion of satisfactory equipment/system operation during the first month after issue of a Certificate of total Performance of the Work.
- .4 **Stage 4:** Successful completion of satisfactory equipment/system operation during the 3rd month after issue of a Certificate of total Performance of the Work.
- .5 **Stage 5:** Successful seasonal commissioning of the building.

3.6 Responsibilities of the Commissioning Agent

.1 **Construction Phase:** During the construction phase the Commissioning Agent shall:
- .1 Review the Contractor’s shop drawings for commissioning related issues, and report any such issues to the Consultant.
- .2 As soon as possible after project start-up, prepare and issue a Commissioning Plan based on the Contractor’s construction schedule.
- .3 Prior to tests, supply and issue operational performance test commissioning data sheets for all equipment and systems to be commissioned.
- .4 Monitor and inspect the installation on a regular basis throughout the construction stages, issue reports identifying any issues which may have an impact on the commissioning process, and work with the project team to expeditiously resolve any problems that may arise due to site conditions.

.5 Arrange with the Contractor for on-site commissioning meetings on an as-required basis, to be attended by the Contractor and applicable subcontractors, the Owner, and the Consultant, chair the meetings, and prepare and distribute meeting minutes to all attendees.
.6 Witness and validate tests, identify deficiencies, and issue progress reports.
.7 Coordinate commissioning scheduling with the Contractor.
.8 Review the final TAB report on site with the Contractor, and check 100% of TAB results for fan equipment, 30% of TAB results for duct systems outward from fan equipment, and issue a report to the Consultant.
.9 For smaller multiple items of equipment such as air terminal boxes, fan coil units, backflow preventers, and similar equipment, review completed commissioning data sheets submitted by the Contractor and review data sheet information on-site with the Contractor for 30% of the quantity of each item of equipment.
.10 Review operational performance test commissioning data sheets submitted by the Contractor, then witness and supervise functional performance testing and supervise and direct the commissioning process, validate the commissioning procedures, witness completion of commissioning data sheets by the Contractor, and sign the completed data sheets.
.11 Perform a preliminary review of the Contractor's O & M Manuals, before they are issued to the Consultant, and issue any comments to the Consultant.
.12 Coordinate with the Contractor and Owner the training and instructions by the Contractor and his equipment and system manufacturers/suppliers to the Owner's operating and maintenance personnel, and comment on the quality of the training and instructions to the Consultant.
.13 Prepare and issue to the Owner prior to equipment and system training by the Contractor, the Systems Operation Manual.

.2 **Post Construction Phase:** During the post construction phase the Commissioning Agent shall:
.1 Prepare and issue the final report on commissioning, identifying any deficiencies that remain outstanding.
.2 Recommend any training and/or instructions to be given to the Owner's operating and maintenance personnel in addition to training and instructions already given.
.3 After Substantial Performance, witness system checks and validate documentation by the Contractor as follows:
.1 Once during the 1st month of building operation.
.2 Once during the 3rd month of building operation.
.3 Once between the 4th and 10th month of building operation but during a season opposite to the 1st or 3ed month visits.
.4 Ensure that any deficient work resulting from system checks described above are corrected.
.5 3 months after Substantial Performance, attend a question and answer session(s) with the Contractor to answer any questions and concerns related to commissioning work from the Owner's operating personnel.

3.7 Responsibilities of the Consultant

.1 **Construction Phase:** Responsibilities of the Consultant are as follows:
.1 Review the Contractor's shop drawing/product data submissions for general conformance requirements of the Contract, and add any review comments made by the Commissioning Agent as applicable.
.2 Review the Contractor's delivery schedule and installation program to ensure that the installation sequences have been coordinated with the construction schedule.
.3 Monitor and inspect the mechanical work throughout the construction stages to ensure that the work is in accordance with requirements of the Contract, witness tests, note deficient work, and ensure that deficient work is corrected.
.4 Attend site commissioning meetings requested by the Commissioning Agent and arranged by the Contractor.

.5 When informed by the Contractor that work is essentially complete, inspect the equipment and systems, issue deficiency reports, and ensure that deficiencies are corrected in a timely manner.

.6 With the Commissioning Agent, review the Commissioning Plan to ensure that proposed tests and the sequencing and methods of tests conform to Contract requirements, and that the testing and commissioning sequences coincide with the construction schedule.

.7 With the Commissioning Agent, certify completion of the commissioning.

3.8 Responsibilities of the Contractor

.1 **Construction Phase:** Responsibilities of the Contractor during the construction phase are as follows:

.1 Prepare and submit an installation schedule which shall include the time schedule for each activity with lead and lag time allowed and indicated, shop drawing/product data and working detail drawing submissions, and major equipment factory testing and delivery dates.

.2 Prepare and submit a commissioning schedule which shall include a time schedule coordinated with the installation schedule referred to above, and allowances for additional time for re-tests as may be required, and update the schedule on a monthly basis as required.

.3 When requested by the Commissioning Agent, arrange site commissioning meetings with the Owner, Consultant, and applicable subcontractors present, to be chaired by the Commissioning Agent who will also prepare and distribute meeting minutes.

.4 Promptly correct all reported deficient work, and report when corrective work is complete.

.5 Where required by Codes and/or the Specification, retain equipment manufacturers/suppliers or independent third parties to certify correct installation of equipment/systems.

.6 Under the supervision of equipment manufacturers/suppliers, start-up and adjust all equipment to design requirements, and submit start-up sheets which include all equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by the equipment manufacturer/supplier and the Contractor.

.7 Complete the Commissioning Agent’s commissioning data sheets for all multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit the sheets to the Commissioning Agent, accompany the Commissioning Agent for an on-site check of 30% of the data sheet information for each type of equipment, and perform any corrective action required as a result of the site checks.

.8 Perform system testing, adjusting and balancing and, when complete, issue a copy of the final report to the Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by the Commissioning Agent.

.9 In accordance with the updated commissioning schedule and actual progress at the site, certify in writing to the Consultant and the Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully operationally performance tested and documented, and are ready for functional performance testing and the commissioning procedures, giving the Consultant and Commissioning Agent a minimum of 5 working days notice.

.10 Perform system and subsystem functional performance testing in the presence of the Commissioning Agent and under the supervision of the Commissioning Agent, and submit to the Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by the Commissioning Agent) and also signed by the Commissioning Agent.

.2 **Post Construction Phase:** Responsibilities of the Contractor during the post construction phase are as follows:

.1 Optimize system operation in accordance with the building's occupant's needs and comments using the System Operation Manual prepared by the Commissioning Agent as reference.

.2 Complete all commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during the construction phase.

.3 Accompanied by the Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows.

.1 Once during the 1st month of building operation.

.2 Once during the 3rd month of building operation.

.3 Once between the 4th and 10th months in a season opposite to the 1st and 3rd month visits.

.4 Correct all deficiencies revealed by the system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work.

.5 Schedule for 3 months after Substantial Performance and conduct question and answer session(s) at the building with the Owner's operating and maintenance personnel, with the duration of the session(s) dictated by the number of questions and concerns that have to be addressed.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each applicable Section and shall be read accordingly.

1.2 Contractual Relationship with a Testing and Balancing Agency

.1 Retain and pay for the services of a qualified testing and balancing agency to perform testing, adjusting and balancing work specified in this Section.

1.3 Submittals

.1 **Draft Report:** Submit a draft report, as specified in Part 3 of this Section.

.2 **Final Report:** Submit a final report, as specified in Part 3 of this Section.

.3 **Post Construction Site Visit Reports:** Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.4 Definitions

.1 The following are definitions of words used in this Section:
- .1 “TAB” – means testing, adjusting, and balancing to determine and confirm quantitative performance of equipment and systems and to regulate the specified fluid flow rate and air patterns at the terminal equipment, e.g., reduce fan speed, throttling, etc.
- .2 “Hydronic systems” – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- .3 “Air systems” – includes all outside air, supply air, return air, exhaust air, and relief air systems.
- .4 “Flow rate tolerance” – means the allowable percentage variation, minus to plus, of actual flow rate values in the Contract Documents.
- .5 “Report forms**”** – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form the permanent record to be used as the basis for required future testing, adjusting and balancing.
- .6 “Terminal” – means the point where the controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- .7 “Main” – means the duct or pipe containing the system’s major or entire fluid flow.
- .8 “Sub-main” – means the duct or pipe containing part of the systems’ capacity and serving two or more branch mains.
- .9 “Branch main” – means duct or pipe servicing two or more terminals.
- .10 **“**Branch” – means duct or pipe serving a single terminal.

1.5 Quality Assurance.

.1 **Standards:** Testing, adjusting, and balancing of the complete mechanical systems shall be performed over the entire operating range of each system in accordance with 1 of the following publications:
- .1 National Standards for A total System Balance published by the Associated Air Balance Council.
- .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by the National Environmental Balancing Bureau.
- .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 Scope of Work

.1 The TAB Agency shall perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting the results.

.2 Mechanical systems to be tested, adjusted, and balanced include:

- .1 **Domestic Water Systems:** TAB of domestic water systems (all piping extended from the Municipal main) shall include:
  - .1 Domestic hot water recirculation piping.
  - .2 Tempered water piping flows.
- .2 **Heating Systems:** TAB of heating systems shall include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the heating season, a follow-up site visit during the heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .3 **Cooling Systems:** TAB of cooling systems is also to include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .4 **Air Handling Systems:** TAB of air handling systems shall include all equipment and ductwork air temperatures, capacities, and flows.
- .5 **Existing Systems:** The following existing systems, revised as part of the mechanical work, are to be tested, adjusted, and balanced as for new systems:

3.2 Testing, Adjusting and Balancing

.1 **General Requirements:** Conform to the following requirements:

- .1 As soon as possible after award of Contract, the Agency shall carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and shall issue a report listing the results of the evaluation.
- .2 The set of drawings examined by the Agency shall be returned with the evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices.
- .3 Testing, adjusting, and balancing is not to begin until:
  - .1 Building construction work is substantially complete and doors have been installed.
  - .2 Mechanical systems are complete in all respects, and have been checked, started, and adjusted.
- .4 All mechanical systems to be tested, adjusted, and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing.
- .5 Obtain copies of reviewed shop drawings of all applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences.
- .6 The Agency shall walk each system from the system "head end" equipment to terminal units to determine variations of installation from design, and the system installation trades will accompany the Agency.
- .7 The Agency shall check all valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment.
- .8 Wherever possible, the Agency shall lock all balancing devices in place at the proper setting, and permanently mark settings on all devices.

.9 For belt-driven equipment, the Agency shall report any situation where fan drive sheaves have to be replaced to suit testing and balancing, and replacements are to be done by the Contractor at no cost.

.10 **Noise:** the Agency shall balance all systems with due regard to objectionable noise which shall be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at the design conditions, the Agency shall immediately report the problem and submit data, including sound readings, to permit an accurate assessment of the noise problem to be made.

.11 **Tolerances:** the Agency shall perform testing, adjusting and balancing to within ± 5% of design values, and make and record measurements which are within ± 2% of actual values.

.12 **Filters** for all air handling systems equipped with air filters, test and balance the systems with simulated 50% loaded (dirty) filters by providing a false pressure drop.

.13 **Seasonal requirements:** test, adjust and balance air conditioning systems during the summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.

.2 **Preparation of Reports:** Prepare reports as indicated below.

.1 **Draft Reports:** Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be handwritten, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.

.2 **Final Report:** Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. Use units of measurement (SI or Imperial) as used on the Project Documents. The final report is a prerequisite to Substantial Performance.

.3 **Report format:** Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the divisions listed below, separated by divider tabs:

.1 General Information and Summary.
.2 Plumbing Systems.
.3 Air Systems.
.4 Temperature Control Systems.
.5 Special Systems.

.4 **Report Contents:** The Agency shall provide the following minimum information, forms, and data:

.1 Inside cover sheet to identify the Agency, the Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of the instrumentation used for the procedures along with the proof of calibration.

.2 The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard AABC or NEBB report forms prepared for each respective item and system.

.3 The Agency shall include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying all equipment, terminals, and accessories.

.4 The Agency shall include report sheets indicating building comfort test readings for all rooms.

.3 **Verification of Reports:** After the final testing and balancing report has been submitted, the Agency shall visit the site with the Contractor and Consultant to spot check results indicated on the balancing report. The Agency shall supply all labour, ladders, and instruments to complete spot checks. Note that if results of spot checks do not, on a consistent basis, agree with the final report, the spot check procedures will stop and the Agency shall then rebalance the systems involved, resubmit the final report, and again perform spot checks with the Contractor and Consultant.

.4 **Post Balancing Site Visits:** Include for two 8-hour day site visits after Total Performance of the work. During each return visit and accompanied by the Owner's representative, the Agency shall spot rebalance terminal units as required to suit building occupants and eliminate complaints.

END OF SECTION

1 GENERAL

1.1 Application

.1 This Section specifies fire stopping and smoke seal requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Submittals

.1 **Firestop & Smoke Seal System Samples:** at least four weeks prior to work commencing, submit a sample of each type of firestop and smoke seal system in applied form, for approval. Submittal shop drawing to include proposed asbestos free material, anchorage construction details and method of installation. Identify each system with the manufacturer's name and type, the ULC designation, and the proposed use. When the samples are approved, all work shall conform to the approved samples.

.2 **Product Data & WHMIS Sheets:** Submit a product data sheet and a WHMIS sheet for each firestopping and smoke seal product.

.3 **Name & Experience of Proposed Applicator:** Submit for approval the full company name and experience of the proposed firestopping and smoke seal system applicator.

.4 **Letter of Certification:** Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.3 Quality Assurance

.1 **Applicator:** The applicator shall have a minimum of 3 years of successful experience on projects of similar size and complexity, and shall be approved by the Consultant.

.2 **Environment Conditions:** Comply with the firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 PRODUCTS

2.1 Firestopping and Smoke Seal System Materials

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.

.2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

.3 Pipe insulation forming part of a fire and smoke seal assembly is specified in the Mechanical Insulation Section.

.4 Fire resistance rating of the installed product shall not be less than the surrounding rating in walls and floors for which the fire stopping material is applied and be an effective barrier against flame, smoke and gases.

2.2 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

3 EXECUTION

3.1 Installation of Firestopping and Smoke Seal Materials

.1 Where mechanical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.

.2 **Preparation:** Abide by the following requirements:

- .1 Examine substrates, openings, voids, adjoining construction, and conditions under which the firestop and smoke seal system shall be installed, and confirm compatibility of surfaces.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Ensure that substrates and surfaces are clean, dry and frost free.
- .4 Maintain insulation around pipes and ducts penetrating a fire separation without interruption to the vapour barrier.
- .5 Verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings.
- .6 Report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces.
- .7 Mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces.

.3 **Application:** Conform to the following application requirements:

- .1 Use an experienced applicator approved by the manufacturer of the firestopping material manufacturer.
- .2 Prime substrates in accordance with the product manufacturer's written instructions.
- .3 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to a neat, smooth, consistent finish.
- .5 Remove excess compound promptly as work progresses and upon completion.
- .6 At all fusible link damper locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.

.4 **Inspection:** Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.

.5 **Certification:** On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all mechanical service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets are to conform to the following requirements:
  .1 Shop drawings/product data sheets are to include all products specified in this Section except pipe and fittings, each clearly marked to indicate exactly what is being supplied.

.2 **Installer Qualifications:** Immediately after award of Contract, submit the name of the fire protection company proposed for the work, with documentation to confirm that the company conforms to requirements of this Section of the Specification.

.3 **Test Certificate**: Submit completed NFPA system material and test certificate(s) as specified in Part 3 of this Section.

.4 **Installation**: In compliance with:
  .1 NFPA 13-2019
  .2 2024 BC Building Code

1.2 Quality Assurance

.1 **Codes and Standards:** Fire protection system work shall be in accordance with the following Codes and Standards:
  .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
  .2 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded.
  .3 ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  .4 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  .5 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250).

.2 **Site Personnel:** All site personnel are to be Sprinkler and Fire Protection Installers licensed in the jurisdiction of the work and under the continuous supervision of a foreman who is a journeyman.

.3 **System Installer:** The system installer shall be an experienced fire protection system company with a minimum of 5 years of experience installing fire protection systems in a complex equal to this Project. Where welding is required, they shall be certified to ISO 9001 and CSA-W47.1 for welding.

.4 **Dimensions and Coordination:** Check and verify all dimensions and conditions at the site and ensure that the work can be performed as indicated. Co-ordinate work with all trades at the site and accept responsibility for and the cost of making adjustments to piping and/or spacing to avoid interference with other building components.

.5 **Existing System:** Verify the working condition of all existing fire protection system equipment which has direct interface with the new work and is to remain. Replace with new equipment where necessary.

.6 All system components must be UL and/or ULC listed and labelled, and FM approved.

1.3 Design Requirements

.1 **Sprinkler System Design Criteria**: Fire protection sprinkler work shall be designed in accordance with NFPA 13 and Provincial Standards, and, where required, local building and fire department requirements and the standards of the Owner's Insurer.

.2 **Sprinkler /System Occupancy – Hazard Design requirements:** As per NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

1.4 Fire Alarm Connections

.1 Connect to existing. No changes expected.

1.5 Permits, Fees, and Certificates

.1 Apply for, obtain and pay for all permits required to complete the fire protection work.

.2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.

.3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.6 Guarantee-Warranty

.1 The Contractor shall furnish a written warranty stating that all work executed will be free from defects of material and workmanship for a period of **ONE** year from the date of total performance. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.

.2 The Contractor further agrees that they will, at their own expense, promptly investigate any fire protection malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guarantee-warranty

1.7 Seismic Consultant

.1 Retain and pay for the services of an experienced Seismic Consultant who is a registered professional engineer licensed in the jurisdiction of the work and a member in good standing of a Professional Engineers Association in the jurisdiction of the work.

.2 The Seismic Consultant shall:
- .1 Determine the proper seismic hazard level, design, recommend, and review all proposed fire protection work seismic restraint shop, placement and securing drawings, and sign and stamp all drawings prior to submittal for review as specified below.
- .2 Supervise installation of all fire protection seismic restraint and, when work is complete, certify in writing that the seismic restraint work has been installed in accordance with signed, stamped, and reviewed drawings.
- .3 Prepare and submit to the Municipality and authorities having jurisdiction, on a form approved by the Municipality and authorities having jurisdiction, at the beginning of seismic restraint work and when the work is complete, original signed and sealed Letters of Assurance for the design, installation and field review of all seismic restraint work.

.3 Quality Assurance
- .1 Seismic restraints are to be designed by a Seismic Consultant as specified above, and are to be installed by qualified tradesmen under the supervision of and to the approval of the Seismic Consultant.
- .2 Unless otherwise specified seismic control and restraints are to be designed in accordance with:
  - .1 BC Building Code.
  - .2 Seismic control and restraints for fire protection piping and equipment are to be in accordance with NFPA requirements. When specified and/or required, design is also to include Factory Mutual requirements.

1.8 Requirements for Contractor Retained Engineers

.1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. seismic engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions

professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.

1.9 Functional Testing

.1 Fire Protection Contractor to coordinate with General Contractor for the Testing of Fire Protection and Life Safety Systems to meet CAN/ULC S1001 Integrated Systems Testing of Fire Protection and Life Safety Systems.

.1 Verification is required that fire protection and life safety systems and their components (i.e. fire alarm systems, sprinklers, standpipes, smoke control, door hold-open devices, elevator recalls, smoke and fire shutters and dampers, emergency power, emergency lighting, generators, etc.), including their interconnections with other building systems, are functioning according to the intent of their design.

.2 CAN/ULC-S1001, “Integrated Systems Testing of Fire Protection and Life Safety Systems,” provides the methodology for verifying and documenting that interconnections between building systems satisfy the intent of their design and that the systems function as intended by the Code. Clause 6.1.5 of CAN/ULC-S1001 allows the Integrated Testing Coordinator to accept documented evidence of any tests that have been performed on a system as part of its acceptance testing for the purpose of demonstrating compliance with the integrated testing requirements of that standard, so as to avoid duplication of work.

1.10 Maintenance Testing

.1 In compliance with NFPA 25-2011 “Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems”

1.11 System Testing (New Piping)

.1 Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ±5 psi (0.35 bar) for 2 hours.

.2 Pneumatic: Establish 40 psi (2.7 bar) air pressure and measure drop, which shall not exceed 1½ psi (0.1 bar) in 24 hours. Test pressure tanks at normal water level and air pressure and measure air pressure drop, which shall not exceed 1½ psi (0.1 bar) in 24 hours.

1.12 Painting

.1 All exposed fire protection piping, including hangers, brackets, fittings, etc are to be painted. Sprinkler heads are not to be painted. Mechanical trade to coordinate with the General Contractor.

1.13 Pipe Hangers and Supports

.1 Hangers and supports used in fire protection piping systems shall be listed and labeled by Underwriters Laboratories, UL 203 ““Pipe Hangar Equipment for Fire Protection Service”.

.2 Steel pipe hangers and supports shall have the manufacturers name, part number, and applicable size stamped in the part itself for identification.

.3 Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lb (115 kg) at each point of piping support.

.4 Supports for sprinkler piping shall be in conformance with NFPA 13 and include protection against earthquakes where in seismic zones.

1.14 Firestopping and Smoke Seal System

.1 Review fire and smoke separations as noted on the architectural plans.

.2 Submit digital copy of shop drawings noting all examples of fire/smoke seal penetrations required for this project.

.3 The applicator shall have a minimum of 3 years of successful experience on projects of similar size and complexity, and shall be approved by the Consultant.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

.1 Pipe, fittings, and joints are to be as follows, with exceptions as specified in Part 3 of this Section:

.1 **Schedule 40 Black Steel – Grooved Coupling Joints:** Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N rigid coupling joints, Mechanical T-oulets, Strap-on fittings such as Victaulic "Snap-Let" strap type fittings are not acceptable.

.2 **Schedule 40 Black Steel – Screwed Joints:** Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping shall be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4.

.3 **Schedule 10 Black Steel – Grooved Coupling Joints:** Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N rigid coupling joints. Mechanical T-oulets, Strap-on fittings such as Victaulic "Snap-Let" strap type fittings are not acceptable.

.4 **Schedule 10 Black Steel – Screwed Joints:** Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.

.5 Flexible Pipe: Victaulic Vicflex flexible metallic hose sprinkler head connections, each complete with an attachment bracket, or equivalent.

.6 **Grooved Fittings:** Installation-Ready™ fittings for grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½ (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, red enamel coated. Fittings complete with prelubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa). Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13.

.1 Victaulic grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to welding, threading or flanged methods.

.2 All grooved components shall conform to local code approval and/or as listed by UL/ULC, cULus, FM, or NFPA.

.3 Approved manufacturer: Victaulic

2.2 Sprinkler Heads

.1 Sprinkler heads, unless otherwise specified, are to be as noted on the mechanical drawings.

.2 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match the ceiling colour.

.3 Where exposed pendent heads occur in areas with suspended ceilings, they are to be complete with chrome plated escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with chrome plated escutcheon plates.

.4 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with listed wire guards, chrome plated where in finished areas.

.5 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 93°C (200°F) heads. All other heads, unless otherwise specified or required, are to be 68°C (155°F) rated.

.6 Acceptable sprinkler head manufactures are:
.1 Tyco
.2 Victaulic
.3 Viking
.4 Reliable

2.3 Pipe Hangers and Support

.1 **General:** Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with NFPA 13 requirements, UL 203 ""Pipe Hangar Equipment for Fire Protection Service", as well as the Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to the following requirements:
.1 Unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized.

.2 **Hangers**
.1 Uninsulated pipes 2 inch and smaller:
.1 Adjustable steel swivel ring (band type) hanger, Tolco series B3170.
.2 Adjustable steel swivel J-hanger, Tolco series B3690.
.3 Malleable iron ring hanger, Tolco series B3198R or hinged ring hanger, B3198H.
.4 Malleable iron split-ring hanger with eye socket, Tolco seriesB3173 with B3222.
.5 Adjustable steel clevis hanger, Tolco series B3104 or B3100.
.2 Uninsulated pipes 2-1/2 inch and larger:
.1 Adjustable steel clevis hanger, Tolco series B3100.
.2 Pipe roll with sockets, Tolco series B3114.
.3 Adjustable steel yoke pipe roll, Tolco series B3110.

.3 **Pipe Clamps**
.1 When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, Tolco series B3140 or B3142 with B3200. For insulated lines use double bolted pipe clamps, Tolco series B3144 or B3146 with B3200

.4 Hangers shall be sufficient to support five times the weight of the water-filled pipe plus 250 lb (114 kg) at each point of piping support.

.5 The points of support shall be adequate to support the system.

2.4 Firestopping and Smoke Seal System Materials

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.

.2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

.3 Pipe insulation forming part of a fire and smoke seal assembly is specified in the Mechanical Insulation Section.

.4 Products to be: 3M, Hilti or approved alternate.

3 EXECUTION

3.1 Demolition

.1 Do all required fire protection system demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 Piping Installation Requirements

.1 Provide all required fire protection system piping. Do all piping work in accordance with "Reviewed" shop drawings and NFPA requirements. Unless otherwise specified, piping shall be as follows:

- .1 **For "wet" system piping inside building and above ground**:
  - .1 For piping up to an including 25mm (1") Schedule 40 screwed end black steel pipe with screwed fittings and joints.
  - .2 For piping 32mm (1-1/4") to 40mm (1-1/2") Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints.
  - .3 For piping 50mm (2") and larger Schedule 10 grooved end black steel with Victaulic or equal fittings and coupling joints.
- .2 **For branch sprinkler piping to heads in suspended ceilings, etc.:** flexible piping installed in accordance with the manufacturer's instructions.
- .3 **For "Grooved" fittings**
  - .1 Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove.
  - .2 The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
  - .3 See the latest copy of manufacturers Field Assembly and Installation Instruction Handbook for grooved fittings. Supplemental handbooks for specific product installations shall be provided by the manufacturer and used by the contractor.
  - .4 Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs. Sprinkler bulb protector shall be removed by hand after installation. Do not use tools or any other device(s) to remove the protector that could damage the bulb in any way.
  - .5 The manufacturers factory trained field representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation.
  - .6 The manufacturers representative shall periodically visit the job site and review installation. Contractor shall remove and replace any improperly installed products.

.2 Exceptions to piping requirements specified in paragraph .3 are as follows:

- .1 All "wet" zone steel piping, fittings, unions, couplings, and flanges for fire protection work exposed to weather either inside or outside the building (including parking garages), are to be galvanized.
- .2 All ferrous pipe hangers, supports, and similar hardware used for galvanized steel piping are to be electro-galvanized.

.3 All pipe sizes, pipe routing, equipment quantities and locations, and layout of work shown on the drawings are to assist you during the tendering period. Ensure adequate fire protection system coverage. Do not reduce the size of the fire protection system main or re-route the main unless approved.

.4 All pipe, fittings, couplings, flanges, and similar components are to be cleaned after erection is complete. Any ferrous pipe, fitting, coupling, flange, hanger, support, and similar component which exhibits rust shall be wire brush cleaned and carefully coated with suitably coloured primer.

.5 Slope all horizontal piping so that it may be completely drained. Provide capped drain points.

.6 When fire protection work is complete, test the system components and the overall system(s) and submit completed NFPA material and test certificate(s), and any other documentation required.

3.3 Installation of Sprinkler Heads

.1 Provide all required sprinkler heads. Sprinkler head types are to be in accordance with the following schedule, unless otherwise specified. Sprinkler head manufacturers indicated on the schedule are for type indication purposes. Acceptable manufacturers are listed in Part 2 of this Section.

.2 Refer to drawings for sprinkler head schedule.

.3 Sprinkler head locations must be carefully coordinated with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.

.4 Maintain maximum headroom in areas with no ceilings.

.5 Provide listed guards for heads where they are subject to damage.

.6 Provide high temperature heads in equipment rooms and similar areas over heat-producing or generating equipment.

3.4 Installation of Spare Sprinkler Head

.1 Supply a full complement (to fill cabinet) of spare sprinkler heads of the types used (minimum four of each type) and place in a wall mounting storage cabinet located adjacent to the sprinkler system "head end" equipment where later directed.

3.5 Installation of Pipe Hangers and Supports

.1 Provide all required pipe hangers and supports.

.2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from the structure only.

.3 The spacing between hangers shall not exceed the value given for the type of pipe as indicated in Table 17.4.2.1(a) or Table 17.4.2.1(b) of NFPA 13-2019.

3.6 Firestopping and Smoke Seal System Materials

.1 Where fire suppression piping penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.

.2 **Preparation:** Abide by the following requirements:

- .1 Examine substrates, openings, voids, adjoining construction, and conditions under which the firestop and smoke seal system shall be installed, and confirm compatibility of surfaces.
- .2 Verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings.
- .3 Report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces.

.3 **Application:** Conform to the following application requirements:

- .1 Use an experienced applicator approved by the manufacturer of the firestopping material manufacturer.

.2 Prime substrates in accordance with the product manufacturer's written instructions.
.3 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
.4 Tool or trowel exposed surfaces to a neat, smooth, consistent finish.
.5 Remove excess compound promptly as work progresses and upon completion.
.6 At all fusible link damper locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.

.4 **Inspection:** Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.

.5 **Certification:** On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all fire protection piping service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

.2 **Water Purity Data**: Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance.

1.2 NSF/ANSI/CAN 61, Drinking Water System Components-Health Effects

.1 All products specified in this Section
- .1 All pipe, valves, fittings, accessories, factory supplied products as well as fabricated assembles/spools that are in contact with domestic water are to be NSF/ANSI/CAN 61 and 372 certified 372 for commercial hot and cold-water ratings.
- .2 Listings including tested and approved water contact temperature(s).
- .3 Any products found to be non-compliant with these requirements will be replaced at the contractor’s expense.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

.1 **Soft Copper**: Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.

.2 **Hard Copper - Solder Joint:** Type "K" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using NSF/ANSI/CAN 61 certified silver alloy lead-free solder for cold water pipe, and 95% tin/5% Antimony or silver alloy lead free solder for other services.

.3 **Copper Pressure Coupled Joint:** Type "K" hard drawn seamless copper to ASTM B88 with Viega "ProPress” copper fittings with “Smart Connect” feature, EDPM seals, and pressure type crimped joints made by use of a Rigid tool Co. Model 330-B or Model 330-C electro-hydraulic crimping tool.

.4 **Copper Grooved Joint:** Type: "K" hard drawn seamless copper to ASTM B88.
- .1 Grooved couplings designed with angle bolt pads to provide rigid joint at copper-tubing sizes, complete with Fluor elastomer, Grade P gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, suitable for domestic water temperatures to 180-deg F.
- .2 Gaskets shall be suited for vacuum up to 29.9 in Hg/760 mm Hg. Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 607N.

.5 **Stainless Steel Pressed Joint:** Schedule 10 Type 304/304L to ASTM A312/A312M with Victaulic “Vic Press” couplings, fittings and valves for piping up to 50 mm (2”):
- .1 Fittings to have grade “H” HNBR elastomer O-ring seals; suitable for working pressure up to 3450 kPa (500 psi) and listed and certified to NSF/ANSI/CAN 61 for cold +73°F/+23°C or hot +180°F/+82°C as applicable as well as NSF/ANSI 372 low lead requirements.

.6 **Stainless Steel:** Schedule 40 Type 304/304L to ASTM A312/A312M, threaded with screwed stainless-steel fittings to ASTM A403/A403M for piping to 50 mm (2”) diameter.

.7 **Schedule 10 Roll Grooved:** Piping larger than 50 mm (2”) diameter with Victaulic Co. factory grooved end Type 304/304M stainless steel fittings and cast stainless steel coupling joints with gaskets meeting NSF/ANSI/CAN 61 requirements and Type 316 stainless steel bolts, Victaulic Series 489 rigid type or Series 77S flexible type as required by the location and application.

.8 **Schedule 10 Roll Grooved:** Type 304/304L to ASTM A312 with RX roll grooves for piping larger than 40 mm1-1/2") diameter with Victaulic grooved end couplings, fittings, and valves.

.1 Couplings to have Grade "P" Fluor elastomer gaskets meeting NSF/ANSI/CAN 61 requirements, that are engineered, blended, and extruded in-house by the coupling housing manufacturer, and have an integral center leg to ensure correct alignment of the coupling key with the prepared pipe ends and that are suited for vacuum up to 29.9 in Hg/760 mm Hg.

.2 Ensure Victaulic RX roll sets specifically designed for grooving schedule 10 stainless steel pipe are used. Victaulic Style 807N (2"-6"), 889 (8"-12") rigid type couplings. Victaulic style 841 flange adapters 2" to 6" and Victaulic 445F 8" to 12". For flexible coupling requires contact manufacture.

2.2 Dielectric Unions

.1 Lead-free dielectric unions, each complete with a thermoplastic liner and rated minimum 1725 kPa (250 psi) at 120º C (250º F).

.2 Grooved dielectric transition fittings composed of a copper silicon casting conforming to UNS C87850 and are UL classified in accordance with NSF/ANSI/CAN 61 and NSF/ANSI 372 for ambient +86°F/+30°C and hot +180°F/+82°C potable water. Victaulic 647

2.3 Shut-Off Valves

.1 **Brass & Bronze Ball Valves**: Lead free, Class 600, 4140 kPa (600 psi) non-shock WOG rated, 2-piece, full port ball type valves, each complete with a forged brass or bronze body, blowout-proof stem, solid forged brass or bronze chrome plated ball, "Teflon" or "PTFE" seat, a removable coated steel lever handle marked with valve identification and ends to suit the piping being connected.

.1 Valves in insulated piping are to be complete with stem extensions. Acceptable manufacturers are:

.1 Toyo Valve Co.
.2 Milwaukee Valve Co.
.3 Kitz Corporation.
.4 Combraco Industries Inc. Apollo.
.5 Watts Water Technologies Inc.

.2 **Stainless Steel Ball Valve:** CF8M stainless steel body, full port ball, and stem, PTFE seats, 304 stainless steel handle, nut, and stem washer, with Schedule 10S stainless steel Vic-press and or grooved ends.

.1 Rated for services to 2750kPa (400 psi). Victaulic series P569.

2.4 Check Valves

.1 **Horizontal**: Class 125, bronze, lead-free with identifying tag, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with ends to suit the connecting piping. Acceptable products are:

.1 Toyo Valve Co.
.2 Milwaukee Valve Co.
.3 Kitz Corporation.
.4 Combraco Industries Inc. Apollo.
.5 Watt Water Technologies Inc.

.2 **Vertical**: Equal to Kitz Corp. Code 26, bronze, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with ends to suit the connecting piping.

.3 Grooved End: 2" – 12" (50 – 300 mm) 300 psi (2065 kPa CWP), grooved end Grade CF8M stainless steel body and disc, 17-4PH stainless steel shaft, with 17-4PH or 316 stainless steel spring, and Grade P Fluor elastomer seat. Suitable for vertical or horizontal installation. Acceptable products are:

.1 Victaulic Series 816.

.4 Valves in stainless steel systems shall be of stainless-steel body and disc. BFVs valves with rubber encapsulated discs or body shall not be used and will not be accepted in any application.

2.5 Balancing Valves

.1 Solder, threaded or flanged end type as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

.2 Note: NSF approved for potable applications. Acceptable products are:
- .1 S.A. Armstrong Model CBV Series.
- .2 Tour and Andersson Model STAD Zero Series.
- .3 Watts Industries (Canada) Inc. Model CSM Series.

.3 Drinking Water applications: ½ and ¾" [15 and 20mm], NSF/ANSI/CAN 61-G rated for commercial hot water service (temperature rated to 180F) and certified by the NSF with all wetted parts stainless steel; lead-free construction in compliance with ANS/NSF/ANSI-372; Series 300 stainless steel body, nickel plated brass union nut, and tamper-resistant flow cartridge 300 series stainless steel. Acceptable products are:
- .1 Victaulic "ICSS" Series 76X.

.4 Thermostatic automatic balancing valves for water recirculation must be approved for domestic hot and cold water as per above.
- .1 Provide thermostatic valve for automatic balancing on each recirculation branch.
- .2 Thermostatic balancing valve shall have ability for manual temperature adjustment, c/w lock out feature, built in temperature display and shut off function.

2.6 Drain Valves

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods

2.7 Partition Stops

.1 Equal to Dahl Brothers Canada Ltd. rough brass or bronze key operated partition stops with Teflon impregnated lifetime packing, slotted spindles, extension tubes, stainless steel access plates, and three identified keys.

3 EXECUTION

3.1 Demolition

.1 Do all required domestic water system demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 Piping Installation Requirements

.1 Provide all required domestic water piping.

.2 Piping, unless otherwise specified, shall be as follows:
- .1 For domestic hot and cold water mains and branch lines – Type "K" Copper with soldered joints, grooved joints, or pressure coupled mechanical joints, or 304 Stainless Steel Schedule 10 with pressure coupled joints.
- .2 For domestic hot water recirculation mains and branch lines– 304 Stainless Steel Schedule 10 with pressure coupled joints.
- .3 For 12 mm (½") diameter trap seal primer tubing located underground or in concrete or masonry construction - semi-rigid polyethylene.

.3 Slope all piping so that it can be completely drained.

.4 Provide proper dielectric fittings or unions in all connections between copper pipe and ferrous pipe or equipment.

.5 Secure trap seal primer tubing embedded in concrete to reinforcing steel in a secure manner and be present during the concrete pour to ensure that the tubing is not damaged or dislodged.

.6 Installation of grooved mechanical components.
- .1 Grooved joints shall be installed in accordance with the manufacturer's latest published instructions.
- .2 Gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be blended, extruded, molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- .3 Correct roll sets shall be used for pipe material grooved Victaulic RX rolls for Sched 10 Stainless Steel Victaulic RR roll sets for copper.
- .4 CG1100 Cut grooving tool for CPVC/PVC PGS300 grooved system.
- .5 Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.
- .6 Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed.
- .7 Provide a copy of the manufacturer's project kickoff checklist and confirmation letter of visit. Contractor shall remove and replace any improperly installed products.
- .8 Manufacturer or Owner Rep/Engineer may request at their discretion any field grooved and installed joints be dissembled for verification of pipe groove dimensions.

3.3 Installation of Shut-Off and Check Valves

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.2 In weld flange applications, valves to and including 100 mm (4") diameter are to be ball type. Valves larger than 100 mm (4") diameter are to be butterfly type.

.3 Valves in grooved end system to be grooved end and will be the same manufacturer as grooved couplings, and fittings.

.4 Valves in stainless steel systems shall be of stainless-steel body and disc. Valves with rubber encapsulated ductile iron discs or body shall not be used and will not be accepted in any application.

3.4 Installation of Balancing Valves

.1 Provide balancing valves in domestic hot water recirculation piping where shown or required. At a minimum, balancing valves are required on each domestic hot water recirculation branch line.

.2 Locate each valve such that it is easily accessible.

.3 All balancing valves to also include a check valve.

.4 All Balancing valves used in domestic water applications must be listed and certified to NSF/ANSI/CAN 61 and NSF/ANSI 372.

3.5 Installation of Drain Valves

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

3.6 Installation of Partition Stops

.1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near the floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.7 Piping Expansion and Contraction Facilities

.1 Provide piping expansion loops or expansion compensators with guides and anchors where indicated for piping expansion and contraction facilities. Refer to requirements in the mechanical work Section entitled Piping Expansion Compensation.

.2 Confirm exact locations prior to installation.

3.8 Flushing and Disinfecting Piping

.1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.

.2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.

.3 Flush piping until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.

.4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with requirements of the BC Drinking Water Protection Act and Drinking Water Protection Regulation and to Municipal Requirements, under the supervision of a P. Eng. authorized by the Professional Engineers of British Columbia to perform such work.

.5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of the test results and fill the systems.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in Part 2 of this Section.

.2 **Hydrant Keys**: Prior to Substantial Performance, submit a minimum of 3 identified keys for key operated hydrants.

.3 **Backflow Preventer Inspection/Test Results:** Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.

1.2 NSF/ANSI/CAN 61, Drinking Water System Components-Health Effects

.1 All products, including all piping, valves, fittings, materials, methods, fabricated assemblies or spool and products specified in this Section that are in contact with domestic water are listed and certified to NSF/ANSI/CAN 61 for domestic cold and hot water as well as NSF/ANSI 372 low lead requirement (as applicable), Drinking Water System Components – Health Effects.

1.3 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.

.2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

.1 **Lavatory supply fitting thermostatic mixing valves** - Watts Water Technologies (Canada) Ltd. “Powers”, Lawler Manufacturing Co. Inc., Leonard Valve Co., and Symmons Industries Inc.

2 PRODUCTS

2.1 Lavatory Supply Fitting Mixing Valves

.1 Forged brass, tamper-proof thermostatic mixing valve, certified to CSA-B125.3, Plumbing Fittings, adjustable for water supply between 29°C and 49°C (85°F and 120°F), sized as shown and/or to suit the number of lavatories in the grouping, and complete with:

.1 A valve stops and independent check valve (not integral) and a lockable handle.
.2 A field supplied outlet piping thermometer.
.3 A stainless-steel flush or surface (as shown) wall mounting cabinet with vandal-proof hinged door.

.2 Equal to Masco Canada Ltd. “Delta” recessed wall mounting cabinet with factory installed and tested components consisting of:

.1 An adjustable thermostatic mixing valve certified to CSA-B125.3, Plumbing Fittings.
.2 Cold and hot water inlet copper piping with ball type shut-off valves.
.3 A water temperature sensor.
.4 A solenoid valve.
.5 A power supply box with batteries and AC adapter. Note: final low voltage wiring to the solenoid control from the electrical power 120v supply installed by the mechanical contractor.
.6 A hinged stainless steel lockable cover.

3 EXECUTION

3.1 Installation of Domestic Hot Water Thermostatic Mixing Valves

.1 Provide a domestic hot water thermostatic mixing valve in a wall cabinet where shown. Confirm exact location prior to installation. Adjust the valve to design requirements and

check and test operation. Set maximum temperature limit stops. Identify the valve and its water temperature delivery setting with an engraved nameplate.

.2 Provide wall mounting battery and AC operated mixing valve/solenoid valve units in cabinets under lavatories where shown. Connect to each lavatory supply fitting with protected control wiring in accordance with the manufacturer's printed instructions. Check and test supply water temperatures and operation of each supply fitting and make any required adjustments.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in this Section except pipe and fittings.

.2 **Plumbing Inspection Certificate:** Submit a copy of the plumbing inspection certificate prior to application for Substantial Performance.

1.2 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.

.2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	ACCEPTABLE MANUFACTURERS
Shut-Off, Check & Drain Valves	Watts Canada, Apollo Valves, Crane & Jenkins Valve Group, Red-White Valve Corp.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

.1 Refer to Part 3 of this Section.

2.2 Shut-Off and Check Valves

.1 **Shut-off Valves**: Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with:
- .1 A forged brass body.
- .2 Blowout-proof stem.
- .3 Chrome plated solid brass ball.
- .4 Screwed or flanged ends as required.
- .5 A removable lever handles.

.2 **Check Valves**: Class 125, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valves with screwed ends for vertical piping, and, for horizontal piping, Class 125, bronze 1380 kPa (200 psi) WOG rated swing check valves with screwed or flanged ends as required.

3 EXECUTION

3.1 Demolition

.1 Do all required drainage and vent piping demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 Drain and Vent Piping Installation Requirements

.1 Provide all required drainage and vent piping. Pipe, unless otherwise specified, shall be as follows indicated below.

.2 Piping Above Ground:

PIPE	FITTINGS	JOINTS
For piping to 75 mm (3”) dia., Type DWV copper to ASTM B306	Forged copper solder joint drainage fittings to ASME/ANSI B16.29	50% lead/50% tine solder type
For piping 75 mm (3”) dia. and larger, Class 4000 cast iron to CAN/CSA-B70	Cast iron soil pipe fittings to CAN/CSA-B602	Mechanical coupling type equal to Anaco “Husky” Series 400, 4-strap for pipe to 100 mm (4”) & 6-strap for pipe larger than 100 mm (4”), all to CAN/CSA-B602

.3 Unless otherwise specified, slope horizontal drainage piping above ground in sizes to and including 75 mm (3") diameter 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") diameter and larger 25 mm (1") in 2.4 m (8').

.4 Unless otherwise specified, slope horizontal branches of vent piping down to the fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').

.5 Extend vent stacks up through the roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above the roof (including roof parapets) in vent stack covers.

.6 Provide proper dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.3 Installation of Shut-Off and Check Valves

.1 Provide a shut-off valve and a check valve in the discharge piping of each drainage pump.

.2 Locate valves so that they are easily accessible without the use of ladders or other such devices.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in this Section.

.2 **Certification Letters:** Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this Section.

2 PRODUCTS

2.1 Cast Iron Drainpipe Elbow Restraints

.1 Holdrite 117 Series no-hub stainless steel restraint kits to suit the pipe size and fitting types and locations.

2.2 Cleanouts

.1 **Horizontal Piping:** TY pipe fitting with an extra heavy brass plug screwed into the fitting.

.2 **Vertical Piping:** Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

2.3 Floor Cleanout Terminations

.1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit the floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware. Acceptable products are:
- .1 Zurn Industries # ZN-1602-SP Series
- .2 Jay R. Smith Mfg. Co. #4020-F-C Series
- .3 Mifab Inc. # C1100-XR-1 or #C1000-R-3
- .4 Watts Industries (Canada) Ltd. # CO-200-R-1
- .5 Bibby-Ste-Croix “Wade”

.2 All cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

.3 Where CSA healthcare standards are required: the location of cleanouts within patient care areas shall be located above the flood level rim of the sink within the patient care washroom.

3 EXECUTION

3.1 Installation of Drainage Pipe Fitting Restraints

.1 Provide fitting restraints on cast iron drainage pipe fittings in high rise piping where indicated. Install in accordance with the manufacturer’s instructions.

3.2 Installation of Cleanouts

.1 Provide cleanouts in drainage piping in locations as follows:
- .1 In the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap.
- .2 At or as close as practicable to the foot of each drainage stack
- .3 At maximum 15 m (50') intervals in horizontal pipe 100 mm (4") diameter and smaller
- .4 At maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") diameter
- .5 In the wall at each new urinal or bank of urinals in a washroom
- .6 Wherever else shown on the drawings

.2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4") diameter, and not less than 100 mm (4") diameter in piping larger than 100 mm (4") diameter.

.3 Where cleanouts in vertical piping are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1") of the finished face of the wall or partition.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data Sheets:** Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.

.2 **Colour Charts**: Submit fixture manufacturer's standard colour charts for all fixtures where colours are available but a particular colour is not specified.

1.2 Quality Assurance

.1 Plumbing fixtures and fittings, where applicable, are to be in accordance with requirements of the following standards:
- .1 CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements.
- .2 ASME A112.18.1/CSA B125.1, Plumbing Supply Fittings.
- .3 ASME A112.18.2/CSA B125.2, Plumbing Waste Fittings.
- .4 ASME A112.18.6/CSA B125.6, Flexible Water Connections.
- .5 CSA B125.3, Plumbing Fittings.
- .6 CAN/CSA-B651, Accessible Design for Self-Service Interactive Devices.
- .7 NSF/ANSI/CAN 61, Drinking Water System Components-Health Effects.
- .8 British Columbia Building Code, Section 3 for barrier-free requirements.

1.3 Base Bid and Acceptable Manufacturers

.1 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	ACCEPTABLE MANUFACTURERS
Vitreous China Fixtures	American Standard, Kohler Co.,Toto Ltd.
Fixture Water Supply and Drain Fittings	American Standard, Delta Faucet Co., Zurn Industries Ltd., Chicago Faucet, Cambridge Brass Inc., Moen Inc.
Fixture Carriers	Watts Industries (Canada) Ltd., Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., and Bibby-Ste-Croix "Wade"

2 PRODUCTS

2.1 General Re: Plumbing Fixtures and Fittings

.1 Unless otherwise specified, all vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.

.2 Unless otherwise specified, all fittings and piping exposed to view are to be chrome plated and polished.

.3 All fittings located in areas other than private washrooms are to be vandal-resistant.

.4 All water supply fittings are to be lead-free in accordance with NSF/ANSI 61 requirements.

.5 **Fixture Carriers:** All fixture carriers are to be suitable in all respects for the fixture they support and the construction in which they are located.

.6 **Fixture Exposed Traps:** Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit the fixture type and drain connection.

.7 **Fixture Concealed Traps:** Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to adjustable cast brass with cleanout plugs, all to suit the fixture type and drain connection.

.8 **Fixture Exposed Supplies:** Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit the fixture. Dahl Brothers Canada Ltd, chrome plated “mini-ball” valve assemblies will be acceptable.

.9 **Fixture Concealed Supplies:** Water piping as specified, complete with ball type shut-off valves as specified with the water piping or Dahl Bros. Canada Ltd. ¼ turn “mini ball” valves.

2.2 Caulking

.1 General Electric Series SCS 1200 Silicone Construction Sealant or Dow Corning 781 silicone sealant. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by the Consultant from the sealant manufacturer’s standard colour range.

3 EXECUTION

3.1 Demolition

.1 Do all required plumbing fixture and fitting demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 Installation of Plumbing Fixtures and Fittings

.1 Provide all required plumbing fixtures and fittings.

.2 Where new fixtures and fittings are to be connected to existing piping, include for all required piping revisions.

.3 Connect plumbing fixtures and fittings with piping sized in accordance with the drawing schedule.

.4 Confirm the exact location of all plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.

.5 When installation is complete, check and test the operation of each fixture and fitting. Adjust or repair as required.

.6 **Barrier-Free Fixtures:** Comply with mounting height and other requirements of the governing Code.

.7 **Electronic Lavatory Faucets:** Locate control panels for electronic faucets under the lavatories and recessed into the wall. Coordinate panel installations with the electrical trade who will provide 115 volt power wiring to the boxes.

.8 Provide low voltage wiring in flexible conduit from each box to the faucet.

.9 Connect tempered water piping to each box, and from each box to the faucet. Set each faucet sensor to deliver water for approximately 10 seconds.

.10 **Mixing Valves for Emergency Fixtures**: Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above the floor and secure in place. Check and confirm valve operation and the temperature of the tempered water supply. Provide cabinets where shown. Identify each cabinet and hand three identified cabinet keys to the Consultant prior to Substantial Performance.

3.3 Caulking at Plumbing Fixtures and Fittings

.1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.

.2 Clean areas/surfaces to be caulked and prime in accordance with the sealant manufacturer's instructions. Where damage to a building surface may occur, mask the surface to prevent damage and ensure a clean exact edge to the caulking bead.

.3 Apply caulking using a gun with the proper size and shape of nozzle and force the sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.

.4 If joints have been masked the sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before the sealant begins to skin.

3.4 Commissioning

.1 Commission plumbing fixtures and fittings by proving proper operation.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit shop drawings/product data sheets for all products specified in this Section except piping and unions.

2 PRODUCTS

2.1 Pipe, Fittings, and Joints

.1 **Black Steel - Screwed Joint**: Mild black carbon steel, Grade B, ERW, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 **Black Steel - Grooved End Mechanical Joint**: Mild black carbon steel, Grade B, ERW, ASTM A53, factory or site roll grooved, complete with Victaulic Co. cast ductile iron grooved end fittings, including full flow elbows, conforming to ASTM A536, and Victaulic Style 07 "Zero-Flex" rigid couplings for piping in the Mechanical Rooms and for piping risers, Style 77 standard flexible couplings for all other piping.

.3 **Black Steel - Pressure Coupled Joint**: Schedule 10 mild black steel, ASTM A53, square cut, deburred **and clean**, complete with Viega “MegaPress” 2070 kPa (300 psi) rated, formed, cold drawn steel fittings and couplings with Grade "E" EDPM O-rings and “Smart Connect” feature, and pressure type crimped joints made by use of an electro-hydraulic crimping tool supplied by the fitting manufacturer.

.4 **Soft Copper Pipe**: Type "L" seamless soft copper to ASTM B77.

.5 **Hard Copper - Solder Joint**: Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin/5% Antimony solder joints.

2.2 Piping Unions

.1 **Screwed Piping**: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 **Flanged Piping**: forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.3 Piping Hangers and Supports

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.2 Refer to sub-section 2.4.1 Horizontal Pipe Insulation at Hangers & Supports in Section 20 05 25 Mechanical Insulation.

2.4 Shut-Off Valves

.1 **Ball Type**: Class 600, 4140 kPa (600 psi) WOG rated full port lead free ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, ends to suit the piping being connected, and removable lever handle. Acceptable products are:

.1 Red-White Valve Corp. Fig. 5044AB.
.2 Watts Industries (Canada) Inc. #FBV-3.
.3 Kitz Corp. Code 58.
.4 Victaulic Co. of Canada Ltd. Series 722.
.5 Apollo Valve #77-100.

2.5 Swing Check Valves

.1 **Bronze - Screwed**: Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends. Acceptable products are:
- .1 Red-White Valve Corp. Fig. 238.
- .2 Nibco #T-433-Y.
- .3 Kitz Corp. Code No. 29.

.2 **Steel - Grooved Ends**: Victaulic Co. of Canada Ltd. Series 716 "Vic-Check" grooved end carbon steel check valves suitable for mounting horizontally or vertically (upwards only).

.3 **Cast Iron - Screwed and Flanged**: Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required. Acceptable products are:
- .1 Kitz Corp. Code No. 78.
- .2 Red-White Valve Corp. Fig. 435. (This valve has a cast iron disc – not bronze)

2.6 Vertical Lift Check Valves

.1 Class 150, 1380 kPa (200 psi) WOG rated bronze vertical lift check valves, each complete with screwed ends and a bronze disc. Acceptable products are:
- .1 Toyo Valve Co. Fig. 230A.
- .2 Kitz Corp. Code No. 36.

2.7 Water Check Valves

.1 Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38°C (100°F), non-slam wafer check valves, each complete with a carbon steel body, stainless steel discs, a shaft, springs, disc stop and thrust bearings constructed of type 316 stainless steel, and seat materials to suit the application. The inside diameter of the valve must equal the inside diameter of the connecting pipe. Acceptable products are:
- .1 Gulf Valve Co. "WAFER CHECK".
- .2 Watts Industries (Canada) Inc. Series ICV-125.
- .3 The Metraflex Co. Style CVXX.

2.8 Drain Valves

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

2.9 Circuit Balancing Valves

.1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter. Acceptable products are:
- .1 Armstrong Fluid Technoloies Series "CBVI" screwed or "CBVII" flanged.
- .2 Victaulic Co. of Canada Ltd. (Tour & Andersson) Series 787 screwed, Series 788 flanged, and 789 grooved end, and Series 78K "Koil Kit" valves.

.2 Flow rate for valve must be suitable for flow rate of specified terminal device. Use low flow and ultra-low flow balancing valve where required.

2.10 Air Vents

.1 Refer to Part 2 of the mechanical work Section entitled Hydronic Piping Specialties.

2.11 Pressure Gauges and Thermometers

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

2.12 Pre-Operational Chemical treatment

.1 Refer to the mechanical work Section entitled HVAC Water Treatment.

3 EXECUTION

3.1 Demolition

.1 Do all required hydronic piping system demolition/revision work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 Preparation

.1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

.2 Remove scale and dirt on inside and outside before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

.4 After completion, fill, clean, and treat systems. Refer to Division 23 Section "HVAC Water Treatment".

3.3 Piping Installation Requirements

.1 Provide all required hydronic piping. Pipe, unless otherwise specified, shall be:
- .1 For pipe to and including 50 mm (2") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints, or, for runout piping from mains and risers to terminal equipment, Schedule 10 black steel with Viega "MegaPress" fittings and couplings.
- .2 For pipe 65 mm (2½") diameter and larger, Schedule 40 black steel with grooved ends and Victaulic fittings and couplings, or, Schedule 40 black steel with welding fittings and welded joints.
- .3 For short branch connections to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.

.2 Route piping plumb and parallel to building structure and maintain gradient.

.3 Install piping to conserve building space, and not interfere with use of space and other work.

.4 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents. Use eccentric reducers to maintain top of pipe level.

.5 Group piping whenever practical at common elevations.

.6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Division 23 Section "Expansion Fittings and Loops for HVAC Piping".

.7 Provide clearance for installation of insulation, and access to valves and fittings.

.8 Provide access where valves and fittings are not exposed.

.9 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.10 Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 09 Section "Painting".

.11 Install valves with stems upright or horizontal, not inverted.

.12 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control. Refer to drawing control diagrams and details.

.13 Connect equipment provided as part of the work of other Sections of the Specification with piping as indicated and/or required. Refer to pipe connection details on drawings.

.14 Do not install heating water piping in exterior walls or unheated areas of the building.

3.4 Pipe Joint Connections

.1 Threaded Pipe: Use RectorSeal No. 5, or equal, for general service applications, temperatures from -45°C to 204°C F (–50°F to +400° F), metal or plastic threads, nontoxic, non-hardening, gas pressures to 18 MPa (2600 psi), liquid pressures to 69 MPa (10,000 psi).

.2 **Unions**: Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at all equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on the drawings.

.3 Copper Tubing with Solder Joint Fittings: Use silver brazed joints for piping located in or under concrete slab on ground, condensate piping located in underground conduits and manholes, and for attaching "Brazolet" fittings for service.
- .1 Silver brazing alloy shall comply with ANSI/AWS A5.8, class BCUP-5. Use care in silver brazing to prevent overheating of pipe and fittings. Disassemble solder type valves before silver brazing and keep bodies cool.
- .2 Make other joints with soft solder per Paragraph 2.1.5

.4 Grooved Joint Coupling Systems:
- .1 Install only on piping systems allowed.
- .2 Install in accordance with manufacturer's recommendations.
- .3 Cut grooves are acceptable, all sizes.
- .4 Rolled grooves are acceptable for pipe sizes 3 inches (75 mm) and larger.
- .5 Only standard full flow, long radius fittings and specified couplings are acceptable. Clamp-on, drilled-in tee connections are specifically prohibited.
- .6 Use specified valves.
- .7 Indicate extent of welding, if still required.
- .8 Coordinate insulation and jacketing requirements.

3.5 Dielectric Insulating Fittings

.1 Insulating unions or flanges shall be provided at locations described herein unless noted otherwise.

.2 A shutoff valve shall be provided locally, upstream of dielectric insulating fittings, so that repairs can be made easily on these fittings.

.3 Locations requiring insulating couplings or flanges are as follows:
- .1 At connection points where copper water lines connect to steel domestic water heater tanks.
- .2 At points in water lines where ferrous and other dissimilar metallic pipes are connected together.
- .3 In metallic water and gas service connections into each building within1 m (3’) of the building wall. Install adjacent to the shutoff valve or cock, and aboveground where possible.
- .4 Where steel or cast iron pipe in the ground connects to copper or brass piping above the ground, the transition from steel or cast iron pipe to the copper or brass pipe shall be made aboveground in an accessible location.
- .5 Where copper or brass piping is connected to steel or cast iron piping and the connection is buried in the ground, the connection shall be covered with a protective coal tar tape wrap extending outward at least 1.7 m (5’) on pipes, from the point of connection. The tape shall be Protecto Wrap No.200, or equal. A primer, specifically designed for use with the tape, shall be used. The piping shall be thoroughly cleaned before tape or primer is applied.

3.6 Valve Installation

.1 Piping systems shall be supplied with valves at points shown on the drawings or herein specified, arranged so as to give shut-off and regulating control of piping systems throughout the building.

.2 Valves shall be the full size of the line in which they are installed.

.3 Valves shall be installed in neat arrangements with accessibility for maintenance. No valve shall be installed with its stem pointing down. Globe valves may be installed with stems horizontal, but the preferred position is vertical. All globe and angle valves shall be installed to close against pressure.

.4 **Shut-off Valves**: Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on the drawings. Valves in piping to and including 50 mm (2") diameter are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate all valves so that they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.

.5 **Check Valves**: Provide a check valve in the discharge piping of every pump, and elsewhere in piping where shown on the drawings. Where check valves are required in vertical piping, ensure that they are suitable in all respects for the application. Note that check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.

.6 **Drain Valves**: Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.7 **Balancing Valves**: Provide circuit balancing valves in piping generally where shown on the drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

3.7 Pipe Sleeves

.1 On existing concrete construction, holes for new piping shall be made with power-driven circular cutters. No pipe sleeves are required.

.2 On new concrete construction, provide pipe sleeves where piping passes through concrete floors, walls, or ceilings. Extend sleeve for the full thickness of the concrete with 1/2-inch clearance around pipe for insulation.

.3 On pipe penetrations below grade, caulk space between pipes and pipe sleeves with oakum and mastic, and make watertight.

.4 On other floor and wall locations, secure sleeves to forms so they will not become displaced during pouring of concrete. Fill metal or fiber sleeves on decks with sand. Remove sleeves from openings after removal of forms. Cut-in proper sized holes in concrete to replace sleeves crushed or knocked out of position during pouring of concrete. Caulk space around pipe with mastic and oakum.

3.8 Flushing and Cleaning Piping

.1 Flush and clean new piping in accordance with requirements specified in the mechanical work Section entitled HVAC Water Treatment.

3.9 Testing, Adjusting and Balancing

.1 Leakage test piping as specified in the mechanical work Section entitled Basic Mechanical Materials and Requirements.

.2 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in this Section.

1.2 Base Bid and Acceptable Manufacturers:

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Pressure Relief Valves

.1 ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each capable of relieving the full output of the equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified.

2.2 Air Vents

.1 **Manual Air Vents**: Equal to Maid-O-Mist No. 72, 3.2 mm (⅛") diameter with a screwdriver slot adjustment.

.2 **Automatic Air Vents**: Float actuated air vents, each complete with a semi-steel body and a cap, a stainless steel float assembly and seat, and a neoprene head. Acceptable products are:

.1 Spirax Sarco Ltd., Type 13 WS for system working pressures to 1035 kPa (150 psi), 13 WHS for system working pressures greater than 1035 kPa (150 psi).

.2 Armstrong International Inc. No. 1-AV.

2.3 Strainers

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

2.4 Piping Expansion & Contraction Hardware & Anchors

.1 Refer to Part 2 of the mechanical work Section entitled Piping Expansion Compensation.

3 EXECUTION

3.1 Installation of Pressure Relief Valves

.1 Provide factory set pressure relief valves where shown. Pipe the discharge of each water piping relief valve to drain unless otherwise shown or specified.

.2 Pipe the discharge of each glycol solution piping relief valve back to the system expansion tank or return piping.

.3 Confirm relief valve settings.

3.2 Installation of Air Vents

.1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") diameter and larger piping and all vents in mechanical rooms in accordance with the drawing detail.

.2 Provide 9 mm (3/8") diameter copper drain piping from each automatic air vent to nearest suitable drain and terminate so the discharge is visible. Identify the drain piping.

.3 Where manual air vents are installed, they shall consist of an isolation valve terminated with an elbow, threaded hose connection and hose cap.

3.3 Installation of Strainers

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

3.4 Installation of Piping Expansion Compensation Hardware & Anchors

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

3.5 Installation of Flexible Piping Connections

.1 Provide flexible connections in piping connections to equipment where shown.

.2 Install in accordance with the manufacturer’s instructions.

End of Section

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all water treatment chemical feed equipment and associated hardware.

.2 **Product Literature**: Submit product literature sheets for all chemicals, as well as WHMIS Material Safety Data Sheets for all chemicals.

.3 **Start-Up and Certification Letters**: Submit water treatment manufacturer/supplier certification letters as specified in Part 3 of this Section.

1.2 Base Bid and Approved Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Characteristics of Chemicals

.1 All chemicals specified in this Section are to be non-toxic when released to atmosphere, non-corrosive and non-staining if a leak occurs, and compatible with all system components.

.2 All chemicals must be approved by governing authorities for release into the Municipal sewer system.

2.2 Existing Treatment Systems

.1 The Owner has a contract with a treatment chemical supplier to maintain proper levels of chemical in the building systems. New chemicals and/or treatment delivery hardware are to be supplied by this supplier. Obtain the supplier's name during the bidding process and obtain the required pricing information.

2.3 Piping System Flushing and Cleaning Chemical

.1 Liquid form alkaline type cleaner consisting of a concentrated blend of highly active penetrating agents and detergents with a 12.5 pH and specifically formulated to remove oil, mill scale and oxides from piping and equipment.

3 EXECUTION

3.1 Piping System Flushing and Cleaning

.1 After new heat transfer system piping has been installed and leakage testing has been satisfactorily completed, but before mechanical equipment start-up and performance tests, flush and chemically clean the piping systems.

.2 Provide all required temporary piping connections, including bypass piping to isolate dirt sensitive mechanical plant equipment. Remove instrumentation such as flow meters and switches, orifice plates, meter valves and similar devices and plug pipe openings. Reinstall when flushing and cleaning work has been certified complete by the chemical manufacturer/installer. Ensure that control valves are operational and fully open during flushing and cleaning.

.3 **Flushing Prior to Chemical Cleaning**: Flush the piping, including dead ends, with water to remove loose solids. Clean all strainers. Replace chemical feeder line filters as required. Flush and drain until the water runs clear.

.4 **Chemical Cleaning**: When flushing with water is complete, fill the systems with fresh clean water. Meter the amount of water required to fill each system or otherwise calculate system capacity. Ensure that all air is vented from the systems. Add cleaning chemical as instructed by the chemical manufacturer and circulate the solution for a period of time and

at a temperature as required to produce a clean piping system. Conduct daily pH, conductivity, and total iron tests in accordance with the chemical supplier's instructions.

.5 **Flushing After Chemical Cleaning**: When test results indicate a clean system, drain the solution from the piping, refill with clean water and circulate the water for a minimum of 24 hours to flush out remaining chemical solution, then drain the water from the piping using all drain points and again clean all system strainers and replace filters. Arrange for the chemical supplier to check each system after flushing and cleaning is complete and to certify in writing that flushing and cleaning procedures have been properly performed. Submit a copy of the certification letter. Fill the systems.

3.2 Manufacturer's Certification, Start-Up, and Training

.1 For all water treatment equipment include for on-site certification, start-up supervision, and system training by the treatment chemical manufacturer's representative as follows:

.1 **Equipment and system manufacturer's certification:** refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.

.2 **Start-up:** refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.3 **Demonstration and training:** refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. and include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data:** Submit product data sheets for all products specified in this Section except shop fabricated ductwork and fittings.

.2 **Test Data:** Submit duct leakage test data prior to ductwork being covered from view.

1.2 Quality Assurance

.1 Ductwork shall be in accordance with requirements of the following Standards:
- .1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process.
- .2 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible.
- .3 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems.
- .4 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
- .5 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

2 PRODUCTS

2.1 Galvanized Steel Ductwork

.1 **General:** Galvanized steel sheet shall be hot dipped in accordance with requirements of ASTM A653. Galvanizing for bare uncovered duct to be finish painted shall be G60. All other galvanizing shall be G90.

.2 **Rectangular:** Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 **Round:** Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings, and couplings.

2.2 Metal Duct System Joint Sealant

.1 ULC listed and labelled, premium grade, grey colour, water base, low VOC, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 maximum flame spread rating of 15 and smoke developed rating of 20.
- .1 Robson Thermal Duct Seal
- .2 Duro Dyne Duct Sealer

2.3 Acoustic Lining

.1 Refer to Specification 20 05 25.

3 EXECUTION

3.1 Demolition

.1 Do all required special system ductwork system demolition/revision work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

.2 Clean all existing special system ductwork to be retained and reused in accordance with requirements of the Section entitled Ductwork Cleaning.

3.2 Fabrication and Installation of Galvanized Steel Ductwork

.1 Provide all required standard galvanized steel ductwork, rectangular and/or round and/or flat oval as shown. Note that where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.

.2 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct

pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so that the ductwork does not "drum". All flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing shall meet ANSI/SMACNA Seal Class A requirements.

.3 Prior to fabrication of ductwork, check all drawings for ceiling space, confliction with structural and architectural features and conditions, and the work of other trades, and if duct routing problems or obstructions occur, notify the Consultant immediately.

.4 Variable air volume ductwork from supply fans to boxes shall be as above but rectangular duct take-offs are to be double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and the double taper side shall have an included angle of minimum 60°.

.1 System pressures are expected to be up to **750 Pa (3" w.c.)** positive upstream of VAV terminal boxes. Install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct pressure class designation of **minimum** 750 Pa (3" w.c.) positive.

.5 **Duct Routing and Dimensions:** Confirm the routing of all ductwork at the site and site measure ductwork prior to fabrication. Note that duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at the site are not grounds for a claim for an extra cost.

.6 **Automatic Control Components:** Install (but do not connect) all duct system mounted automatic control components supplied as part of the automatic control work.

.7 **Heat Transfer Equipment Connections:** Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.

.8 **Rectangular Duct Support Inside Building:** Support horizontal rectangular ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, use trapeze hangers with galvanized steel channels, and galvanized steel hanger rods for all ducts that are exposed, and all concealed ducts wider than 500 mm (20"),.

.9 **Round Duct Support Inside Building:** Support round ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If the duct is insulated, size the strap to suit the diameter of the insulated duct.

.10 **Flanged Duct Joints:** Where flanged duct joints are used, do not locate the joints in wall or slab openings, or immediately at wall or slab openings. **Do not use flanged joints for exposed uninsulated ducts in finished areas**.

.11 **Watertight Ductwork:** Where watertight horizontal ductwork is required, construct the ducts without bottom longitudinal seams. Solder or weld the joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide the drain points. Provide watertight ductwork for:

.1 All galvanized steel ductwork outside the building or otherwise exposed to the elements.

.2 Fresh air intakes.

.12 **Leakage Testing:** Leakage testing shall be performed in accordance with the ANSI/SMACNA HVAC Air Duct Leakage Test Manual as well as ASHRAE 90.1-2016 and shall be witnessed by the Consultant. Leakage test the following ductwork:

.13 **Application of Sealants:** Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of the sealant.

.14 **Protective Coating for Exposed Exterior Ducts:** Clean exterior exposed (uninsulated on exterior of duct) ducts with a heavy full coverage of Robson Thermal RT-80 High Velocity Duct Sealant. It is a UV and weather resistant, solvent based elastomeric sealant, with aluminum finish. Install in compliance with manufacturers recommendations.

.15 **Connection of Dissimilar Metal Ducts:** Where dissimilar metal ducts are to be connected, isolate the ducts by means of flexible duct connection material as specified in the Section entitled Duct System Dampers and Accessories.

.16 **Cleanliness of Installed Ductwork:** Maintain all new ductwork in a clean condition. If, at Substantial Performance, in the Consultant's opinion, new ductwork is not in a clean condition, retain and pay for a certified duct cleaning company to clean all new ductwork using compressed air and vacuum cleaning equipment.

.17 **Seismic Requirements:** In addition to ANSI/SMACNA duct construction standards specified above, ductwork shall be constructed and installed to meet seismic requirements of the Building Code and ANSI/SMACNA The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.3 Installation of Flexible Ductwork

.1 Provide maximum 900 mm (36") long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on the drawings.

.2 Stretch out lengths of duct prior to cutting and installation.

.3 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.

.4 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.

.5 Do not penetrate fire barriers with flexible duct.

3.4 Installation of Acoustic Lining

.1 Provide acoustic lining in ductwork in locations as follows:
- .1 Wherever shown and/or specified on the drawings.
- .2 Supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along the duct and outward from the box in all directions.
- .3 Supply ductwork downstream of air handling units or fan coil units for a distance of 2.4 m (8') measured along the duct and outward from the unit in all directions.
- .4 Return ductwork upstream downstream of air handling units or fan coil units for a distance of 2.4 m (8') measured along the duct and outward from the unit in all directions.
- .5 Exhaust ductwork at roof or wall discharge locations for a distance of 2.4 m (8') measured along the duct and inward from the wall or roof penetration.
- .6 Exhaust ductwork downstream of fan connection for a distance of 2.4 m (8') measured along the duct.
- .7 For all transfer air ducts.

.2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel as per the detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.5 Duct System Protection, Cleaning and Start-Up

.1 Temporarily cover all open ends of new ducts during construction.

.2 Vacuum all dirt and foreign matter from the entire duct systems and clean duct system terminals and the interior of air handling units prior to operating fans.

.3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 Provide cheesecloth over all duct system inlets and outlets and run the system for twenty-four hours, after which remove the cheesecloth, the construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following the route of all duct systems to be tested, adjusted and balanced for the purpose of confirming the proper position and attitude of dampers, the location of pitot tube openings, and any other work affecting the testing and balancing procedures. Perform all corrective work required as a result of this walk-through.

3.6 Testing, Adjusting, and Balancing

.1 When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in this Section.

.2 **Test Data:** Submit duct leakage test data prior to ductwork being covered from view.

.3 **Colour Chart(s):** Submit manufacturer's colour chart(s) for all items for which a finish colour shall be selected.

.4 **Fire Rated Duct Installation Certification:** Submit proper installation certification from the fire rated duct manufacturer as specified in Part 3 of this Section.

1.2 Quality Assurance

.1 Ductwork shall be in accordance with requirements of the following Standards:
- .1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A240, Standard Specification for Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .3 ASTM A480, Specification for General Requirements for Flat-Trolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip.
- .4 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .5 ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated (Vinyl Chloride) (CPVC) Compounds.
- .6 ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- .7 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible.
- .8 ANSI/SMACNA Round Industrial Duct Construction Standards.
- .9 ANSI/SMACNA Rectangular Industrial Duct Construction Standards.
- .10 SMACNA Thermoplastic Duct (PVC) Construction Manual.
- .11 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems.
- .12 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
- .13 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .14 CAN/CGSB-41.22, Fiberglass-Reinforced Plastic Corrosion-Resistant Equipment.
- .15 CAN3-A23.1, Concrete Materials and Methods of Concrete Construction.
- .16 CSA S269.1, Falsework and Formwork.
- .17 CAN/ULC-S115, Standard Methods of Test of Firestop Systems.
- .18 UL 1978, Standard for Grease Ducts.
- .19 UL 2221, Standard for Fire Resistive Grease Duct Enclosure Assemblies.
- .20 American Conference of Governmental Hygienists, Industrial Ventilation: A Manual of Recommended Practice for Design.

1.3 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.

2 PRODUCTS

2.1 Round Stainless Steel Ductwork

.1 Factory made, spiral, mechanically locked flat seam, single wall duct fabricated from type 316 stainless steel to ASTM A480 with metal gauges in accordance with ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible for 2.5 kPa (0.36 psi) pressure. Fittings and couplings are to be factory made type 316 stainless steel fittings equipped with leak-proof couplings secured to the connecting duct by means of stainless steel sheet metal screws and duct sealer. Duct system performance shall meet SMACNA's Leakage Class 3 requirements at the system design static pressure. The stainless steel finish shall be a #2B

mill finish where concealed or exposed in unfinished areas, and a #4 finish where exposed in finished areas.

3 EXECUTION

3.1 Demolition

.1 Clean all existing ductwork to be retained and reused in accordance with requirements of the Section entitled Ductwork Cleaning.

3.2 General Re: Fabrication and Installation Special Systems Ductwork

.1 Provide all required special systems ductwork, rectangular and/or round as shown. **Note** that where rectangular ductwork is shown (except for in-slab type), round or flat oval ductwork of equivalent material and cross-sectional area is acceptable.

.2 Unless otherwise specified, construct and install special systems ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct pressure class designation of **minimum** 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so that the ductwork does not "drum". All flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing shall meet SMACNA Seal Class A requirements.

.3 Prior to fabrication of special systems ductwork, check all drawings for ceiling space, confliction with structural and architectural features and conditions, and the work of other trades, and if duct routing problems or obstructions occur, notify the Consultant immediately.

.6 **Duct Routing and Dimensions:** Confirm the routing of all ductwork at the site and site measure ductwork prior to fabrication. Note that duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at the site are not grounds for a claim for an extra cost.

.7 **Automatic Control Components:** Install (but do not connect) all duct system mounted automatic control components supplied as part of the automatic control work.

.8 **Round Duct Support Inside Building:** Support round ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If the duct is insulated, size the strap to suit the diameter of the insulated duct. Unless otherwise specified, duct support hardware for metal duct shall be constructed of the same material as the duct, and for non-metal duct, type 316 stainless steel.

.9 **Support of Roof Mounted Ducts:** As specified in the mechanical work Section entitled Duct System Dampers and Accessories.

.10 **Watertight Ductwork:** Where watertight horizontal ductwork is required, construct the ducts without bottom longitudinal seams. Solder or weld the joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide the drain points. Provide watertight ductwork for:
- .1 All ductwork outside the building or otherwise exposed to the elements.
- .2 Dishwasher exhaust.
- .3 Shower exhaust ducts from grilles to the duct main or riser.
- .4 A minimum of 3 m (10') upstream and downstream of duct mounted humidifiers or humidifier manifolds.
- .5 Wherever else shown and/or specified.

.11 **Leakage Testing:** Leakage testing shall be performed in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and shall be witnessed by the Consultant. Leakage test the following ductwork:

.1 Exhaust air duct for BSC

.12 **Application of Sealants:** Seal all ductwork as per SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of the sealant.

.13 **Protective Coating for Exposed Exterior Ducts:** Clean exterior exposed (uninsulated) ducts with a heavy full coverage of solvent-free, fast curing, rubberized asphalt coating.

.14 **Connection of Dissimilar Metal Ducts:** Where dissimilar metal ducts are to be connected, isolate the ducts by means of flexible duct connection material as specified in the Section entitled Duct System Dampers and Accessories.

.15 **Cleanliness of Installed Ductwork:** Maintain all new special systems ductwork in a clean condition. If, at Substantial Performance, in the Consultant’s opinion, new ductwork is not in a clean condition, retain and pay for a certified duct cleaning company to clean all new ductwork using compressed air and vacuum cleaning equipment.

.16 **Counterflashing Duct Roof Curbs:** Do all required counterflashing work for roof curbs for special systems ductwork penetrating the roof. Counterflashing materials are to match roof flashing materials provided as part of the work of Division 07. Caulk around the top edge of the counterflashing, and attach vertical counterflashing to the curb using non-ferrous screws with coloured heads to match counterflashing if coloured material is used. Counterflashing work shall be watertight.

.17 **Seismic Requirements:** In addition to SMACNA duct construction standards specified above, ductwork shall be constructed and installed to meet seismic requirements of the British Columbia Building Code and ANSI/SMACNA The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.3 Installation of Stainless Steel Ductwork

.1 Provide stainless steel ductwork, round or rectangular as shown.

.2 Provide stainless steel ductwork as follows:
.1 Exhaust air duct for BSC

3.4 Duct Systems Cleaning and Start-Up

.1 Remove all dirt and foreign matter from the entire duct system and clean duct system terminals and the interior of supply air handling units prior to operating fans.

.2 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.3 Provide cheesecloth over all duct system inlets and outlets inside the building and run the system for 24 hours, after which remove the cheesecloth, the construction filters, and install new permanent filters.

.4 Include all labour for a complete site walk-through with testing and balancing personnel following the route of all duct systems to be tested, adjusted and balanced for the purpose of confirming the proper position and attitude of dampers, the location of pitot tube openings, and any other work affecting the testing and balancing procedures. Perform all corrective work required as a result of this walk-through.

3.5 Testing, Adjusting, and Balancing

.1 When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in this Section.

.2 **Colour Chart(s):** Submit manufacturer's colour chart(s) for all items for which a finish colour shall be selected.

1.2 Quality Assurance

.1 Duct system dampers and accessories are to be in accordance with requirements of the following Standards:

.1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A240, Standard Specification for Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A480, Specification for General Requirements for Flat-Trolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip.

.4 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.5 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible.

.6 ANSI/SMACNA Round Industrial Duct Construction Standards.

.7 ANSI/SMACNA Rectangular Industrial Duct Construction Standards.

.8 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems.

.9 CAN/ULC-S110, Standard Methods of Test for Air Ducts.

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

.11 American Conference of Governmental Hygienists, Industrial Ventilation: A Manual of Recommended Practice for Design.

1.3 Base Bid and Acceptable Manufacturers

.1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.

.2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	MANUFACTURERS
Manual Balancing (Volume) Dampers	Nailor Industries Inc., T. A. Morrison & Co. Inc. "TAMCO", NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Backdraft Dampers	Nailor Industries Inc., T. A. Morrison & Co. Inc. "TAMCO", NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Fusible Link Dampers	Nailor Industries Inc., NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Combination Fire/Smoke Dampers	Nailor Industries Inc., NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Flexible Connection Material	Duro Dyne Canada Inc., Dyn Air Inc.
Motorized Control Dampers	Nailor Industries Inc., T. A. Morrison & Co. Inc. "TAMCO", NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.

2 PRODUCTS

2.1 Round to Rectangular Duct Connections

.1 Galvanized steel, flared, flanged or notched as required, "SPIN-IN" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.2 Splitter Dampers

.1 Minimum #20 gauge damper blade constructed of the same material as the duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to Dyn Air Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.3 Air Turning Vanes

.1 For square elbows - multiple-radius turning vanes with runner channels, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same material as the duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 For short branch ducts at grille and diffuser connections - air extractor type, each equipped with a matching bottom operated 90º opposed blade volume control damper, constructed of the same material as the duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.4 Manual Balancing (Volume) Dampers

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of the same material as the connecting ductwork unless otherwise specified, each designed to maintain the internal free area of the connecting duct, and each complete with:

- .1 A hexagonal or square shaft extension through the frame.
- .2 Non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers.
- .3 Blade stops for single blade dampers, designed to prevent the blade from moving more than 90°.
- .4 Linkage for multiple blade dampers.
- .5 A locking hand quadrant damper operator with, for insulated ducts 50 mm standoff mounting.

.2 **Rectangular Dampers:** Maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.

.3 **Round Dampers:** Maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.

.4 **Multiple Rectangular Damper Section Assembly:** Rectangular assembly supplied with the dampers or site constructed of the same material as the damper and designed for tight and secure mounting of the individual dampers.

2.5 Backdraft Dampers

.1 Counterbalanced backdraft dampers, 65 mm (2½") deep, sized as shown and complete with:

- .1 Extruded aluminum frame and blades, minimum 1.58 mm (1/16") thick, with captive extruded silicone blade gaskets and side seals in slots integral with the aluminum extrusions.
- .2 Damper blade counterweights internal to the frame and consisting of adjustable weights fastened to brackets which are riveted to the blades.

.3 Dual PVC linkage tracks at each end of the blades, and non-corrosive linkage with hard alloy aluminum pivot arm and bearings equal to Ticona "Celcon" acetal copolymer bearings.

2.6 Fusible Link Dampers

.1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to Standard CAN/ULC-S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1 1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.

.2 Fusible link dampers are to be Type "B" or Type "C" (as required) with the folded curtain blade out of the air stream. If the damper size or location requires the use of type “A” dampers with the curtain blade in the air stream, review with the Engineer prior for approval.

.3 Fusible link dampers in ductwork other than galvanized steel are to be as specified above but constructed of Type 316 stainless steel.

2.7 Combination Fire/Smoke Dampers

.1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) combination fire/smoke dampers, ULC classified to Standard CAN/ULC-S112, 1 1/2 hour fire rated, leakage Class I smoke rated, normally closed, low pressure drop design, dynamically tested, type "B" or "C" as required, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the fire barrier opening, a fusible link to close and lock the damper without disengaging the actuator, and an electric 115 volt actuator to automatically close the damper upon receiving an external signal, and to automatically open the damper when the system is reset.

2.8 Flexible Connection Material

.1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber.

.2 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber.

2.9 Duct Access Doors

.1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, generally with sizes suitable in all respects for the purpose for which they are provided but minimum 225 mm x 225 mm (9” x 9”) for hand access and 450 mm x 450 mm (18” x 18”) for man access, and, unless otherwise specified, constructed of the same material as the duct they are associated with.

2.10 Ductwork Drain Points

.1 Equal to Ductmate Canada Ltd. "DUCTMATE MOISTURE DRAIN", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.11 Instrument Test Ports

.1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leak-proof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.12 Motorized Control Dampers

.1 Factory assembled, 100 mm (4") deep, flanged aluminum control dampers with AMCA certified maximum leakage through a 1.2 m x 1.2 m (4' x 4') damper of 52 L/s/m^2 (110 ft^3/min) against 1 kPa (0.145 psi) differential static pressure. Control dampers for mixing

applications are to be parallel blade type. Control dampers for open-shut service are to be opposed blade type.

.2 **Standard Damper:** Standard dampers are to be complete with:
- .1 Extruded 6063T5 aluminum frame and blades, each with an integral slot to receive a gasket.
- .2 Extruded silicone frame gaskets and extruded EPDM blade gaskets.
- .3 Slip-proof aluminum and corrosion resistant plated steel linkage concealed in the frame, equipped with self-sealing and self-lubricating bearings consisting of an inner bearing equal to a Ticona "Celcon" bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.

.3 **Insulated Damper:** As specified for standard dampers but with all 4 sides of the frames insulated with injected polyurethane foam, and with the blades thermally broken and insulated with expanded polyurethane foam.

.4 **Damper Motor:** Equal to Belimo CSA certified, spring return, direct coupled electric motor damper actuator, 120 volt or 24 volt as required, electronic overload protected, complete with position indicator, a housing to suit the mounting location, and additional features as required to suit the application and control sequence.

3 EXECUTION

3.1 Installation of Round to Rectangular Duct Connections

.1 Cut round holes in rectangular ducts using a purpose made hole cutter and provide round to rectangular “Spin-In fittings with dampers for connection of flexible round ductwork. Seal the cut duct around the fitting.

3.2 Installation of Splitter Dampers

.1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on the drawings. Install splitter dampers so they cannot vibrate and rattle and so that the damper operation mechanisms are in an easily accessible and operable location. Ensure that operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.3 Installation of Turning Vanes

.1 Provide turning vanes in ductwork square elbows where shown on the drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.4 Installation of Manual Balancing (Volume) Dampers

.1 Provide manual balancing dampers in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install balancing dampers at least 2 m (6’) upstream of grilles and diffusers where space permits.

.3 Install the dampers so that the operating mechanism is accessible and positioned for easy operation, and so that the dampers cannot move or rattle. Ensure that operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.4 Where a duct for which a balancing damper is required has dimensions larger than the dimensions of the maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.

.5 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.5 Installation of Backdraft Dampers

.1 Provide backdraft dampers where shown, including at the inlet to any exhaust fan not equipped with an automatic control damper.

.2 Install and secure the dampers so that they cannot move or rattle.

3.6 Installation of Fusible Link Dampers

.1 Provide fusible link dampers where shown and/or specified on the drawings. Ensure that the damper rating (1½ or 3 hr.) is suitable for the fire barrier it is associated with.

.2 Install dampers with retaining angles on all four sides of the sleeve on both sides of the damper and connect with ductwork in accordance with the damper manufacturer's instructions and details to meet Code requirements.

.3 Provide expansion clearance between the damper or damper sleeve and the opening in which the damper is required. Ensure that the openings are properly sized and located, and that all voids between the damper sleeve and the opening are properly sealed to maintain the rating of the fire barrier.

.4 When requested by the Owner or Consultant, demonstrate operation of several randomly picked fire dampers, and reset after successful demonstration.

.5 Where the size of the fire barrier opening requires the use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC - S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.7 Installation of Combination Fire/Smoke Dampers

.1 Provide combination fire/smoke dampers where shown and/or specified on the drawings. Install dampers with retaining angles on all four sides of each side of the damper, and, where required, connect with ductwork, all in accordance with the damper manufacturer's instructions and details, and Code requirements.

.2 Coordinate damper installation with the electrical work where electrical connections to damper actuators are specified.

3.8 Installation of Flexible Connection Material

.1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or casings connect to fans, and wherever else shown or specified.

.2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of the flexible fabric and to the fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure that connections to the flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

.3 For any system carrying high temperature exhaust or process air, use high temperature flameproof flexible connection material suitable for the application.

3.9 Installation of Duct Access Doors

.1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Locate access doors at both the air entering and leaving side of each device.

.2 Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.3 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure that the doors are properly located for damper maintenance.

.4 When requested, submit a sample of proposed duct access doors for review.

.5 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce the ductwork to suit the access door installed.

3.10 Installation of Instruments Test Ports

.1 Provide instrument test ports in all main ducts at connections to fans, plenums, or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.

.2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.11 Installation of Motorized Control Dampers

.1 Provide motorized control dampers where shown. Secure in place to prevent movement or rattle, and to prevent air bypass around the damper.

.2 Provide insulated dampers in fresh air intake ductwork or openings, and for exhaust air service at exterior walls.

.3 Equip each damper with an electric motor actuator, 120 volt or 24 volt as required. Ensure that each actuator is equipped with all required features to suit the application.

3.12 Control Wiring

.1 Provide all required power wiring for controls from 15A-1P circuits terminated in junction boxes adjacent to the control work, and do all control wiring to connect control components.

.2 Install wiring in conduit in accordance with electrical work wiring material and installation requirements.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for the fans and accessories. Include the following:
- .1 Certified fan performance curves.
- .2 Product data for all accessories.
- .3 Product data for fan motors.

1.2 Quality Assurance

.1 Utility fan manufacturers are to be current members of the Air Movement and Control Association International Inc. (AMCA), and the fans are to be rated (capacity and sound performance) and certified in accordance with requirements of the following standards:
- .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating.
- .2 AMCA Standard 211, Product Rating Manual for Fan Air Performance.
- .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance.
- .5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

1.3 Base Bid and Approved Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Utility Fans

.1 Centrifugal, single width and inlet, factory run tested utility fans as per the drawing schedule, and capable of operating over the complete pressure class limits as specified in AMCA Standard 2408.

.2 **Housing Assembly:** Rotatable, continuously welded heavy-gauge steel housing, coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked, braced and reinforced with structural steel members to prevent vibration or pulsation, equipped with a spun, aerodynamically designed inlet cone, and an attached welded steel bearing and motor support platform.

.3 **Wheel:** Welded aluminum or welded steel wheel coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked, statically and dynamically balanced.

.4 **Fan Shaft, Bearings, Drive and Guard**: for belt driven fans only, AISI C-1040 or C-1045 hot rolled steel shaft, accurately turned, ground, polished, and ring gauged for accuracy, and sized for a first critical speed of at least 1.43 times the maximum rated speed for the fan, equipped with heavy-duty, grease lubricated, ball, pillow block type bearings, selected for a minimum average AFBMA L-50 bearing life of 200,00 hours at the maximum fan RPM, and secured to the bearing support platform, and an adjustable V-belt drive with OSHA guard (weather cover) in accordance with requirements of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.5 **Motor**: NEMA Premium TEFC motor conforming to requirements of the mechanical work Section entitled Basic Mechanical Materials and Requirements.

.6 **Finish**: Unless otherwise specified, the finish shall consist of rust inhibiting primer applied to cleaned and deburred metal surfaces prior to assembly, then a second coat of primer after assembly and an air dried epoxy enamel finished coat both inside and outside to a 3 mil dry film thickness.

.7 **Seismic Restraint Hardware:** Factory secured seismic restraint connection hardware.

3 EXECUTION

3.1 Installation of Utility Fans

.1 Provide utility fans where shown.

.2 Secure each indoor base mounted fan in place, level, and plumb, on vibration isolation on a concrete housekeeping pad.

.3 Secure suspended units in place from the structure, level, and plumb, by means of vibration isolation spring hangers, properly sized galvanized steel hanger rods, and galvanized structural steel angle or channel trapeze supports.

.4 Secure each outdoor fan in place, level, and plumb, on vibration isolation on a site fabricated base.

.5 Brace and secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.

.6 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.

.7 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.8 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

.9 **Demonstration and Training:** Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for inline fans and accessories. Include the following:
  .1 Certified fan performance curves.
  .2 Product data for all accessories.
  .3 Product data for fan motors.

1.2 Quality Assurance

.1 Inline fan manufacturers are to be current members of the Air Movement and Control Association International Inc. (AMCA), and the fans are to be rated (capacity and sound performance) and certified in accordance with requirements of the following standards:
  .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating.
  .2 AMCA Standard 211, Product Rating Manual for Fan Air Performance.
  .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
  .4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance.
  .5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

1.3 Base Bid and Approved Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Centrifugal Inline Fans

.1 Centrifugal, ULC listed, factory run tested rectangular inline fans as per the drawing schedule.

.2 **Housing**: Heavy-gauge galvanized steel with removable side panels to permit removal of the power assembly without disturbing duct connections, universal mounting brackets and hardware including spring vibration isolators to accommodate horizontal or vertical mounting as required, a flanged inlet panel with inlet venturi, a flanged outlet panel, both with integral duct connection collars, and galvanized steel wire grid fan inlet/outlet guard(s), corrosion resistant fasteners.

.3 **Fan Wheel**: Non-overloading aluminium wheel with backward inclined blades with matching inlet venturi, statically and dynamically balanced as an assembly, inlet shall overlap an aerodynamic aluminum inlet cone.

.4 **Fan Shaft, Bearings, Drive and Guard: for** belt-drive fans only, hot rolled steel shaft, accurately turned, ground, and polished, and sized for a first critical speed of at least 1.25 times the maximum rated speed for the fan, and heavy-duty, self-aligning pillow block type bearings selected for an AFBMA L-50 minimum average life in excess of 500,000 hours and equipped with lubrication line and fitting, and an adjustable V-belt drive with guard conforming to requirements of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.5 **Motor and Disconnect Switch:** TEFC motor conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods, completes with a minimum of class B insulation for continuous duty, mounted out of the airstream, complete with a cover, and factory prewired to a NEMA 4 disconnect switch.

.6 **Accessories**: for fans as scheduled, factory supplied accessories as follows:
  .1 For fans as scheduled, housing insulation (lining), consisting of neoprene spray coated glass fibre semi-rigid insulation meeting NFPA 90A requirements and 25/50 smoke developed/flame spread requirements of CAN/ULC S102, permanently secured in place with no exposed edges.

.2 Factory secured seismic restraint connection hardware and ceiling mounted type spring isolator.

3 EXECUTION

3.1 Installation of Centrifugal Inline Fans

.1 Provide inline centrifugal fans where shown.

.2 Secure each fan in place from the structure with vibration isolation, either horizontally or vertically as indicated, independent of connecting ductwork and in accordance with the fan manufacturer's published instructions.

.3 Brace and secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.

.4 Ensure that duct connections are made using flexible connection material.

.5 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.

.6 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.7 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

.8 **Demonstration and Training:** Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data:** Submit product data sheets for air terminals. Include the following:
- .1 Capacity and pressure drop.
- .2 Sound power data to verify conformance with specified sound power levels.
- .3 Leakage and dimensions.
- .4 Mounting details to suit locations shown, indicating methods and hardware to be used.
- .5 Control components and a control wiring schematic.

.2 **Test Report:** Submit with shop drawings/product data, a test report in accordance with ANSI/AMCA Standard 210 requirements and ISO 3741, published test data on DIN (Direct Internal Noise) made by an independent testing agency for 2.5 and 6 m/s (8.2 and 19.7 ft/min) branch velocity or inlet velocity, sound power levels with a minimum inlet pressure of 0.25 kPa (0.036 psi) as per ISO 3741 for the second through seventh octave bands, and confirmation that pressure loss through a silencer will not exceed 60% of inlet velocity pressure maximum. For venturi valve, each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than plus or minus one percent of signal over the entire range of measurement. Airflow control devices shall be further calibrated and their accuracy verified to plus or minus five percent of signal at a minimum of 48 different airflows across the full operating range of the device.

.3 **Site Inspection and Start-Up Report**: Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.

1.2 Quality Assurance

.1 Air terminals manufacturers are to be current members of the Air-Conditioning, Heating and Refrigeration Institute (AHRI), and the terminals are to be in accordance with requirements of the following standards:
- .1 AHRI Standard 880, Performance Rating for Air Terminals.
- .2 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating.
- .3 International Organization of Standardization (ISO) Standard IS) 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure-Precision Methods for Reverberation Rooms.

.2 **Seismic Restraint Hardware:** Boxes are to be equipped with factory secured seismic restraint connection hardware.

1.3 Base Bid and Approved Manufacturers

.1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10, **1.6** – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Variable Air Volume Terminal Units

.1 Single duct, controller type, pressure independent variable air volume boxes as per the drawing schedule, each individually field adjustable to minimum and maximum air volumes. Terminal box sound power levels with an attenuator or lined discharge duct in place are not to exceed sound power levels, in decibels, of 61, 53, 48, 44, 42 and 41 in octave bands 2 to 7 respectively at specified air quantities and 370 kPa (55 psi) entering static pressure. Each box shall be complete with:
- .1 **Housing:** #22 gauge galvanized steel, sealed and gasketed, internally lined with minimum 25 mm (1") thick duct lining material with a neoprene coating meeting NFPA 90A and CAN/ULC-S102 25/50 flame spread and smoke developed requirements, and complete with:

.1 Exposed cut edges of the liner material factory coated with NFPA 90A and CAN/ULC-S102 approved sealant.
.2 A 50 mm (2") long, round inlet duct connection.
.3 A rectangular discharge opening with slip and drive cleat duct connection facilities.
.4 A protective galvanized steel shroud for the controller and damper actuator.
.5 Casing leakage shall be tested in accordance with ASHRAE 130.

.2 **Fiber-free Insulation:** Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84. The insulation shall be secured with adhesive.

.3 **Air valve damper:** normally open, galvanized steel blade with peripheral gasket, pivoting in self-lubricating bearings and with air leakage past a closed damper of 2% or less of rated capacity at 750 Pa (3" wc) inlet static pressure.

.4 **Air flow sensor**: located at the box inlet, complete with gauge taps, multiple pressure sensing ports, and an averaging chamber designed to accurately average the flow across the inlet of the box with an accuracy of within +/- 5% with a 90°sheet metal elbow located directly at the inlet, and amplify the sensed air flow signal.

.5 **Controller/actuator**: supplied as part of the controls work specified in mechanical work Automatic Controls Section, shipped to the box manufacturer's plant by the controls supplier, and factory installed, connected, tested, calibrated and set by the box manufacturer.

.6 **Attenuators**: #22 gauge galvanized steel c/w minimum 25mm (1") thick internally lined fibre free attenuators, housings, each factory supplied loose and with a minimum 1500mm (60") length or as per the drawing schedule.

.7 **Thermostat and accessories:** wall mounting thermostat with thermometer and guard, supplied with the Terminal Unit by the manufacturer or controls contractor, suitable in all respects for the Terminal unit controls and the control sequence, and complete with all required installation and connection accessories.

2.2 Venturi Valve

.1 Single duct, controller type, pressure independent venturi valve as per the drawing schedule, each individually field adjustable to minimum and maximum air volumes. Each box shall be complete with:

.1 **Housing:** non-corrosive 14-gauge aluminum (valve body) and 16-gauge aluminum (valve cone) construction. The center shaft shall be PTFE Teflon coated 316 stainless steel. The center shaft support brackets shall be 316 stainless steel. The pivot arm and internal mounting link shall be 316 Stainless Steel. The pressure independent springs shall be spring-grade stainless steel. All shaft bearing surfaces shall be Teflon.

.1 Supply valves shall be insulated with ¾ inch flexible closed-cell polyethylene insulation with a flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
.2 Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction.

.2 **Actuation:**

.1 For electrically actuated VAV operation for tracking pairs (supply and exhaust valves), and two-position valves in laboratory spaces without fume hoods, a low-speed electric actuator shall be used to modulate the airflow over the range of the specific valve size.
.2 A UL or CSA listed electronic actuator shall be factory mounted to the valve. The actuator shall have sufficient torque to modulate the airflow against the maximum duct static pressure (within product specifications). Loss of main power shall cause the valve to maintain its last airflow position. This position shall be maintained until power is restored.

.3 For electrically actuated VAV operation for fume hood laboratories (includes all supply, general exhaust, and fume hood valves in the space), a high speed UL 916 listed electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state:
- .1 Supply/make-up air valves:
  - .1 Fail to last airflow position.
- .2 General exhaust air valves:
  - .1 Fail to last airflow position.
- .3 Fume Hood air valves:
  - .1 Fail to last airflow position.

.4 This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).

.5 Constant volume valves for biosafety cabinets, snorkel exhaust, canopy exhaust, etc. shall maintain a constant volume pressure independent, manually adjustable, volume airflow setpoint. It shall be factory calibrated and set for desired airflow rate. It shall also be capable of field adjustment for future changes of desired airflow rate. Valve shall not be equipped with any pneumatic or electronic control actuator requirements. Valve airflow and pressure feedback is not required for constant volume valves.

.3 **Thermostat and accessories:** wall mounting thermostat with thermometer and guard, supplied with the Terminal Unit by the manufacturer or controls contractor, suitable in all respects for the Terminal unit controls and the control sequence, and complete with all required installation and connection accessories.

3 EXECUTION

3.1 Installation of Air Terminal Units

.1 Provide/Install ceiling mounted terminal units where shown.

.2 Secure each unit in place from the structure by means of galvanized steel angles and hanger rods, independent of connecting ductwork.

.3 Brace and seismically secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.

.4 Connect each unit with ductwork as indicated. Provide straight inlet duct the same size as the unit inlet and of a length equal to a minimum of four duct diameters. Refer to the drawing detail. Co-ordinate final Terminal Unit adjustments and settings with personnel doing system testing and balancing work.

.5 **Testing, Adjusting and Balancing:** When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

.6 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.7 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

.8 **Demonstration and Training:** Refer to the article entitled Equipment and System O&M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 3 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data:** Submit product data sheets for grilles and diffusers. Product data shall include capacity, throw and terminal velocity, noise criteria, pressure drops, and neck velocity.

.2 **Damper Adjustment Keys:** Supply and hand to the Owner at Substantial Performance, a minimum of 10 identified (with tags) grille/diffuser volume control damper and flow pattern adjustment keys.

.3 **Colour Chart(s):** Submit manufacturer's colour chart(s) for all grilles and diffusers for which a finish colour shall be selected.

1.2 Quality Assurance

.1 Grilles and diffusers are to be tested and performance certified to the Air-Conditioning and Refrigeration Institute Standard ARI 650, Standard for Air Outlets and Inlets.

.2 Acceptable manufacturers are:
- .1 Price Industries Inc.
- .2 Tuttle & Bailey
- .3 Krueger Division of Air System Components Inc.
- .4 Titus
- .5 Nailor Industries Inc.

2 PRODUCTS

2.1 Grilles and Diffusers

.1 Grilles and diffusers of the type, size, capacity, finish, and arrangement as shown on the drawings and as per the drawing schedule, each equipped with all required mounting and connection accessories to suit the mounting location and application.

.2 Deflection and spacing shall be as identified in the equipment schedule.

.3 Grilles and diffusers shall be of steel and aluminum construction, unless otherwise scheduled.

.4 Where specified, provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.5 All grilles installed in gymnasiums shall be "heavy duty" steel construction with fully welded perimeter and mandrel tubes that support the blades.

2.2 Laminar Flow Diffuser with HEPA Filter

.1 Diffuser shall be as per Equipment Schedule on the drawings.

.2 Construction:
- .1 The diffuser shall consist of a ceiling mounting frame, a perforated face, an airtight filter housing, a remote operated volume control damper, and a replaceable high efficiency filter.
- .2 The border shall be extruded aluminum construction with an integral knife edge flange which penetrates gel in the filter frame to provide a leak-proof seal.
- .3 Plenum and knife edge shall be factory PAO scanned according to standard IEST-RP-CCO34.3 to ensure a leak free assembly.
- .4 A static pressure port accessible from the room side shall be factory supplied to measure pressure drop across the filter, and to sample aerosol concentrations before the filter.
- .5 Air shall be admitted to the plenum through an inlet collar and an optional butterfly style volume control damper.

.6 The diffuser plenum shall feature four (4) integral hanger tabs for securing the unit to structural supports above the ceiling.
.7 Mounting frames shall utilize corner alignment brackets.
.8 Four (4) thumb wheel retainers hold the filter in the housing, allowing filter removal and replacement without disturbing the ceiling seal or duct connections.
.9 The 51% free-area perforated distribution plate shall be secured to the face using quarter-turn fasteners with anti-slip, snap-in retainers and stainless steel retainer cables for ease of installation and removal.

.3 Finish:
.1 The perforated face, plenum, and damper shall have a white B12 baked-on powder coat finish.
.2 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
.3 The paint film thickness shall be a minimum of 2.0 mils.
.4 The finish shall have a hardness of 2H.
.5 The finish shall withstand a minimum salt spray exposure of 1000 hours.
.6 The finish shall have an impact resistance of 80 in-lb.
.7 The filter housing and inlet connection shall be mill finish coated steel.

.4 Filter:
.1 The filter shall be a two inch thick pleated microglass element in a three inch deep anodized aluminum frame.
.2 The filter shall have an integral cavity filled with gel which shall provide a leak tight seal between the filter frame and the border.
.3 Filters shall be packaged separately from the filter housing in a factory carton until site conditions are appropriate for installation (by others) of the filter in the housing.
.4 The filter shall be held in place by four cam-type retainers which can be turned 90 degrees by hand, providing an easy means of removing and replacing filters without disturbing the filter housing in the ceiling or the duct connection.
.5 The filter shall be individually tested for particle penetration and initial air flow resistance, and shall be of type (select one):
.6 High Efficiency Particulate Air (HEPA) filter shall provide 99.99% efficiency on 0.30 µm particulate.

.5 Diffuser Finish:
.1 As scheduled or otherwise required by architect, confirm prior to ordering.
.1 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
.2 The paint film thickness shall be a minimum of 2.0 mils.
.3 The finish shall have a hardness of 2H.
.4 The finish shall withstand a minimum salt spray exposure of 1000 hours.
.5 The finish shall have an impact resistance of 80 in-lb.

.6 Inlet damper:
.1 Steel construction with standard white B12 baked-on powder coat finish.
.2 Stainless steel construction with brushed finish.

3 EXECUTION

3.1 General

.1 Install in accordance with manufacturers instructions.

.2 Provide grilles and diffusers where shown on the drawings. Wherever possible and unless scheduled otherwise, grilles and diffusers are to be the product of one manufacturer.

.3 Contractor is responsible to determine the final quantity of the grilles and diffusers to suit the requirements of the drawings.

.4 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.5 Exactly locate grilles and diffusers to conform to the final architectural reflected ceiling plans and detailed wall elevations, and to conform to the final lighting arrangement, ceiling layout, ornamental and other wall treatment.

.6 Coordinate grille and diffuser accessories to suit ceiling systems, ie flanges, t-bar lay-in, etc.

.7 Where possible, mount grilles such that the blades of the grille are oriented to reduce visual impact, so that interior of duct systems, ceiling systems, etc cannot be seen. Paint inside of connecting duct black should it not be possible to avoid visual impact noted above.

.8 Order imperial or metric grilles and diffusers to suit actual ceiling dimensions.

.9 Do not locate supply air terminals within 1200mm (48”) of return or transfer terminals unless explicitly shown on the drawings.

.10 Do not locate grilles and diffusers behind furniture. Notify Consultant immediately for furniture arrangements that will block air diffusers and grilles.

.11 Contractor shall cover and protect grilles and diffusers during construction to prevent from damage and entrainment of construction dust into ductwork systems.

.12 Thoroughly clean all grilles and diffusers prior to placing into service.

.13 Install with flat head stainless steel screws in countersunk holes where fastenings are visible.

.14 Do not support components from ductwork.

3.2 Installation of Grilles and Diffusers

.1 Where louvered face grilles are installed in occupied spaces, orient louvered blades such that sightlines into ductwork are obstructed by the blades, unless noted specifically otherwise on the drawings.

.2 Equip supply diffusers having a basic four-way or all-round air pattern for operation in one, two, or three way pattern where indicated on the drawings.

.3 Attach troffer type diffusers associated with typical ceiling mounted fluorescent lighting fixtures to the fixtures on the floor prior to fixture installation in the ceiling. When fixtures are installed, connect diffuser boots with flexible ductwork.

.4 Provide sheet metal plenums, constructed of the same material as the connecting duct, for linear grilles and/or diffusers where shown. Construct and install the plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip the duct connection collar(s) with volume control device(s).

.5 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip the diffusers/grilles in place using clip supplied by the diffuser/grille manufacturer.

.6 Confirm grille and diffuser finishes prior to ordering.

.7 Bolt grilles, registers, and diffusers in place and provide safety chains in gymnasiums and similar rooms or areas where the grille, register and diffuser may be subject to damage.

3.3 Installation of Laminar Flow Diffuser with HEPA filter

.1 Exactly locate radial flow diffusers to suit mechanical drawings to optimal air pattern in associated space. Diffusers are not to be relocated unless approved by the Consultant.

.2 Contractor to conform to the final architectural reflected ceiling plans, and to conform to the final lighting arrangement and locations of ceiling equipment.

.3 Replace, at the Contractor's cost, any damaged HEPA filters regardless of the severity of the damage. At the Consultants request for concerns with the installation, coordinate and pay for any DOP filter performance testing.

.4 **Testing:** Prior to putting into service, complete DOP HEPA filter testing to verify proper installation and performance. Replace any filters that fail testing. Testing shall be carried out in accordance with AS1807.6 and 1807.7.

.5 **Demonstration and Training:** Refer to the article entitled Demonstration and training in the Mechanical Work General Instructions Section. Include for a demonstration on proper use and care for fan filter diffusers to protect filters from damage during service and maintenance.

3.4 Seismic Restraint

.1 Brace and secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.

.2 All air outlets mounted in a T-bar ceiling shall be seismically restrained by:
- .1 Secure attachment to solid ductwork that is braced at the outlet
- .2 Wire hangers attached to structure. Minimum of two (2) per outlet and one per 1200mm (48") length.

.3 Air outlets other than T-bar mounting must be securely fastened to the building elements.

END OF SECTION

1 GENERAL

1.1 Submittals

.1 **Product Data**: Submit product data sheets for all products specified in this Section.

.2 **Spare Filters:** Prior to Substantial Performance submit a set of spare filters in original identified packaging for each air handling unit requiring filters. Store filters on the site where directed by the Consultant or Owner.

.3 **Spare Filter Gauge Oil**: Prior to Substantial Performance submit a spare bottle of red manometer filter gauge oil, with instructions, to the Owner for each manometer type gauge installed.

2 PRODUCTS

2.1 General

.1 Unless otherwise specified or noted, filters are to be synthetic and/or glass fibre disposable media type in accordance with the drawing schedule(s).

.2 Minimum Efficiency Reporting Values (MERV) ratings are to be as per ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Sizes.

.3 Unless otherwise specified or noted, filters are to be in accordance with UL Standard 900, Air Filter Units.

.4 Acceptable filter manufacturers are:
- .1 AAF International.
- .2 Camfil Farr Inc.
- .3 Modern Air Filter Corp.

2.2 Construction Filters

.1 Roll type, disposable, MERV 7 to 9 woven glass fibre media.

2.3 HEPA Filters

.1 HEPA high capacity filters as per the drawing schedule, in accordance with UL Standard 586, High-Efficiency, Particulate, Air Filter Units, 99.995% efficient on 0.12 µm particles, consisting of a continuous pleating of water-proof micro glass fibre media with pleats uniformly separated by aluminum separators, urethane sealant to encapsulate the filter pack in the minimum #16 gauge galvanized steel frame with one-piece urethane gasket or neoprene dove-tailed gasket for positive leak-free filter-to-holding mechanism seal.

2.4 Filter Framing and Racks

.1 No. 16 gauge galvanized steel filter framing/racks, sized and arranged to suit the filters and filter bank, easily accessible for filter service and replacement, and complete with slide-in tracks or lay-in flanges as required for filter placement, and all required gasketing and facilities to prevent air by-pass.

3 EXECUTION

3.1 Installation of Construction Filters

.1 Provide roll type medium efficiency disposable media filter(s) across the entire filter bank of each supply air handling unit, either at the factory where the fan is produced or at the site as soon as the fan is installed. Secure the media in place so it will not be dislodged by fan operation. Replace the roll media periodically if it becomes loaded and clogged.

.2 For exhaust systems, secure the filter media across exhaust air openings and ductwork to prevent construction dirt and dust from fouling the fan

.3 Leave the media in place until fan start-up, at which time remove and dispose of the construction media.

3.2 Installation of Filters

.1 Provide all required filter media when fan equipment is ready for start-up and performance testing. Provide any required filter framing/racks.

.2 Prior to Substantial Performance supply a complete spare set of filter media in original packaging and clearly identified as to the applicable system for each air handling system with filters. Store the filters at the site where directed by the Owner.

END OF SECTION

1 GENERAL

.1 Existing building DDC control is Delta Controls by Ainsworth.

1.2 Submittals

.1 **Shop Drawings/Product Data**: Submit shop drawings/product data sheets for the following:
- .1 All control system components.
- .2 Identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems.
- .3 Certified wiring diagrams for all systems.

.2 **Site Inspection and Start-Up Report**: Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.

.3 **Confirmation of Installation Personnel Qualifications:** Submit written confirmation from the control component manufacturer that the site installation personnel are qualified and experienced in the installation of the components, and have parts and service availability on a 24/7 basis.

1.3 Quality Assurance

.1 The control systems are to be installed by the control component manufacturer or by licensed personnel authorized by the control component manufacturer. Submit written confirmation from the control component manufacturer.

.2 The control system installation company shall have local parts and service availability on a 24/7 basis.

.3 All control wiring work shall be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 PRODUCTS

2.1 Control Dampers and Operators

.1 **Standard Damper:** T. A. Morrison & Co. Inc. "TAMCO" Series 1000, 100 mm (4') deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length shall be 1 m (4'). Dampers greater than two sections wide are to be complete with a jackshaft. Each damper shall be complete with:
- .1 An extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket.
- .2 Extruded TPE frame gaskets and extruded EPDM blade gaskets.
- .3 Slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in the frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.

.2 **General Re: Damper Operators**: Each damper motor shall be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control the damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit the sizes of dampers involved, and to provide sufficient force to maintain the damper rated leakage characteristics. Each operator shall be complete with a damper position indicator, and external adjustable stops to limit the length of stroke in either direction, and shall be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to the damper shaft. Operators for dampers to be connected to the building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit the dampers to respond and go to the

required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for the environment in which they are located.

.3 **Electric Damper Operators**: Equal to Belimo EF Series 24 volt or 120 volt AC spring return, direct coupled electric motor operators for either modulating or two position control as required. Each operator shall be overload protected and complete with an enclosure to suit the mounting location.

2.2 Local Control Panels

.1 NEMA/EEMAC 1 (NEMA/EEMAC 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.3 Control System Components

.1 Components specified below are required for control of equipment and systems as per the drawing control diagrams and sequences of operation. Not all required components may be specified.

.2 **Building Automation System Interface Hardware:** Hardware to permit building automation system control and monitoring of input/output points as per the mechanical work Section entitled Building Automation System, the points schedule, and drawing control diagrams and operation sequences. All such hardware shall be suitable in all respects for interface with the building automation system.

2.4 Room Pressure Monitor

.1 Description:
- .1 The Room Pressure Monitor shall be an electronic device utilizing a flow-through style sensor, furnished and installed to measure differential room pressure between adjacent spaces and display the information on a digital interface mounted outside the critical space.

.2 Construction:
- .1 Digital Display Unit:
  - .1 The device shall be wall mounted in close proximity immediately outside the space being monitored.
  - .2 Each monitor shall have a 4.3 inch thin-film-transistor (TFT), dimmable, full-color touch-screen display with a 480 x 800 resolution.
  - .3 The device must utilize a password-protected menu format to permit access for programming or setpoint changes. Different levels of secure access shall be available using different passwords.

.3 Room Pressure Sensor:
- .1 The device shall be mounted above the door separating the spaces for which differential room pressure is being measured.
- .2 The sensor shall include cover plates on both sides of the wall for protection from drafts and/or cleaning solvents. The sensor cover plate shall be secured with security fasteners to prevent tampering.
- .3 The sensor shall maintain an accuracy of ±3% of reading. Sensors with accuracy rated as a percentage of full scale shall not be acceptable.
- .4 The sensor shall be capable of monitoring pressure from -0.25 to +0.25 in.w.c.
- .5 The device must utilize digital sensor technology. Flutter strips, ball-in-tube monitors or similar approaches that do not display actual quantitative differential room pressure information are not acceptable.
- .6 Sensor drift shall be less than 0.0004 in.w.c. (0.1 Pa) per year. Sensors with yearly drift specified as a percentage of their full scale range shall not be acceptable.

.7 The sensor element shall be constructed in such a way that it is protected from the effects of dust or lint. Sensors with elements exposed to the airstream are not acceptable.

.4 Alarm:
.1 The monitor shall include the ability for both audible and visual alarming during a user defined event, including low pressure, high pressure, emergency condition, and door status.
.2 The alarm shall incorporate a user defined delay between time when the alarm setpoint is met and when the alarm initiates.
.3 The monitor shall include a mute button which, when depressed during an alarm event, shall disable the audio alarm for a user defined length of time.

.5 Door Switches:
.1 Magnetic door switches shall be utilized to prevent nuisance alarms during room cleaning, patient transfer, or other situations requiring door(s) to be kept open for extended periods of time.
.2 The door switches shall be wired directly to the room pressure monitor, and the alarm delay duration shall be field adjustable through the service menu on the monitor display interface.

.6 Commissioning:
.1 Configuration:
.1 All available settings shall be adjustable through the touch-screen display. Commissioning shall be fully supported through the interface without the use of any additional tools or software.
.2 Duplication:
.1 Each device shall permit the configuration to be copied, and this configuration can be uploaded to additional units if applicable. This is to be done through an Ethernet based connection to a computer.
.3 Reports:
.1 Each device shall have a programmatically generated commissioning report that details all device settings. This is to be done through an Ethernet based connection to a computer.

.7 Building Management System Interface:
.1 The room pressure monitor shall interface with the building management system (BMS) to allow remote monitoring of room parameters or permit settings adjustments over the building network.
.2 The BMS shall use either analog inputs, digital inputs, or utilize BACnet network protocol to view points or status of the room being measured. The use of BACnet protocol shall be native to the device and shall not require the use of an external gateway.
.3 The monitor shall include the ability to change MAC address, device instance, and baud rate (9600, 19200, 38400, 76800) for proper interfacing to BACnet network.
.4 The manufacturer shall be a member of BACnet International and the room pressure monitor shall be BTL listed.

2.5 Touchscreen Multi Variable Room Pressure Monitor

.1 Description:
.1 The Multi Variable Monitor shall be an electronic, touchscreen device capable of displaying a customized graphical user interface.

.2 Construction:
.1 Digital Display Unit:
.1 Each monitor shall have a (7)/(15) inch thin-film-transistor (TFT), dimmable, full-color touch-screen display with a (800 x 480)/(1024 x 768) resolution.
.2 The device shall have an IP54 rating for cleaning of the display surface.

.3 The device shall be able to display information for up to 8 rooms on a single screen
.4 The device shall support the ability to swipe between multiple display screens.
.5 The device must utilize a password-protected menu format to permit access for programming or set-point changes. Different levels of secure access shall be available using different passwords.
.6 The device shall support up to 512 BACnet server points.
.7 The device shall support the following graphic file formats: GIF, JPEG, BMP, TIFF, PNG, MNG, ICO

.2 Multi Variable Monitor:
.1 The device shall support both BACnet MS/TP and BACnet IP network types.
.2 The device shall be capable of displaying any available BACnet point. At minimum this includes alarm status, room temperature and humidity, room pressure, air change rate and occupancy.
.3 The Multi Variable Monitor shall support fully customizable user interfaces. The user interface shall be able to display up to 8 rooms simultaneously.

.3 Alarm:
.1 The monitor shall include the ability for both audible and visual alarming during a user defined event.
.2 The alarm shall incorporate a user defined delay between time when the alarm set-point is met and when the alarm initiates.
.3 The monitor shall include a mute button which, when depressed during an alarm event, shall disable the audio alarm for a user defined length of time.

.3 Building Management System Interface:
.1 The BMS shall use BACnet network protocol to view points or status of the room being measured. The use of BACnet protocol shall be native to the device and shall not require the use of an external gateway.
.2 The monitor shall include the ability to change MAC address, device instance, and baud rate (9600, 19200, 38400, 76800) for proper interfacing to BACnet network.

2.6 System Wiring Materials

.1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in the appropriate Section(s) of the Electrical Work Division of the Specification.

3 EXECUTION

3.1 Demolition

.1 Do all required control system demolition work.

.2 Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 General Re: Installation of Controls

.1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section of the Specification and the drawings.

.2 The control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.

.3 The control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.

.4 Brace and secure control system equipment in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.

3.3 Supply of Control Air Dampers and Operators

.1 Unless otherwise specified, supply all required control dampers. Hand the dampers to the sheet metal trade at the site in the location where they are required for installation as part of the sheet metal work. Ensure that each damper is correctly located and mounted.

.2 Provide linkage and operators for the dampers. Wherever possible locate damper operators so that they are accessible from outside duct, plenum, and equipment casings. Bracket mount operators on ducts or plenums clear of insulation where applicable.

.3 Where sequence operation is indicated, or where multiple operators drive a series of dampers, provide pilot positioners to couple their action.

.4 Ensure that dampers located in ductwork other than galvanized steel are constructed of type 316 stainless steel.

3.4 Supply of Automatic Control Valves and Operators

.1 Unless otherwise specified, supply all required automatic control valves. Hand the valves to the appropriate piping trades at the site in the locations they are required for installation as part of the piping work. Ensure that each valve is properly located and installed.

.2 Provide an operator for each valve.

3.5 Installation of Control System Components

.1 Provide all required control system components and related hardware. Refer to drawing control diagrams, points lists, and sequences.

.2 Where components are pipe, duct, or equipment mounted supply the components at the proper time, coordinate installation with the appropriate trade, and ensure that the components are properly located and mounted.

3.6 Control Wiring

.1 Do all required control wiring from 15A-1P circuits terminated as part of the electrical work in junction boxes in equipment rooms/areas. Coordinate exact junction box locations at the site with the electrical trade.

.2 Except as specified below, install all wiring in conduit. Unless otherwise specified the final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections shall be liquid-tight flexible conduit.

.3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

.4 All wiring work shall be in accordance with certified wiring schematics and instructions, and the wiring standards specified in the appropriate Sections of the Electrical Work Division of this Specification.

3.7 Identification and Labelling of Equipment, Systems and Circuits

.1 Refer to identification requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods.

.2 Identify equipment as follows:

- .1 **Enclosures and components**: engraved laminated nameplates with all wording listed and approved prior to manufacture of the nameplates.
- .2 **Wiring**: numbered sleeves or plastic rings at both ends of the conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.
- .3 Provide a control system glazed and framed flow diagram with component identification and sequence for each control system. Locate the diagrams in the Equipment Rooms housing the system equipment.

3.8 Testing, Adjusting, Certification, Start-Up, Commissioning and Training

.1 **Testing and Adjusting:** When control work is complete, check the installation of components and all wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting and balancing work.

.2 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.

.3 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.4 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

.5 **Demonstration and Training:** Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 2 full day on-site operation demonstration and training sessions for 2 groups of 6 people.

.6 **Additional Training and Troubleshooting:** Include for 2 follow-up site training and troubleshooting visits, 1 six months after Substantial Performance and the other at the end of the warranty period, both when arranged by the Owner and for a full 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

END OF SECTION

1 GENERAL

1.1 Sequences of Operation

.1 The following sequences of operation are to be read in conjunction with the building automation points list. Some inputs and outputs such as current sensors, air and water temperature sensors for information and diagnostics are not identified in the sequence of operation but included in the points list.

.2 Additional virtual points and variables may be required in addition to the items identified in the points list and sequences of operation to achieve the desired equipment operation and performance.

.3 These sequences of operation provide the design intent with respect to the desired operating conditions of the equipment and mechanical systems and do not represent the programming to achieve the sequence.

.4 In general all BACnet points are to be mapped to the DDC system and the Owner/Consultant will select the BACnet points to display on the system graphic. In general BACnet points are to be used for information purposes only and not part of a control sequence. All control points are to be hard wired and they are not be replaced by BACnet control without the approval of the owner and consultant.

1.2 Graphics Points/Display

.1 In general, all DDC system points and global variables for each piece of mechanical equipment shall appear on the DDC system graphics.
.2 The mechanical consultant and Owner may request additional points on each graphic screen to facilitate ease of monitoring of the systems.
.3 In some cases the owner and consultant may request specific BACnet points to also be displayed on the graphics.
.4 Update graphics for deleted and added mechanical equipment within the project scope of work.

1.3 Occupancy Scheduling

.1 Occupancy schedule will remain unchanged.

1.4 Temperature Setpoint Scheduling

.1 All room setpoint temperatures shall be fully adjustable through the BMS (including setpoints outside of the room-level adjustable range indicated in the Room Temperature Setpoint Table).

.2 Limit the range of selectable room setpoint temperatures by the room occupants through the room temperature sensors for each room in accordance with the Room Temperature Setpoint Table.

.3 Set the initial Room Setpoint Temperature in accordance with the Room Temperature Setpoint Table. Building temperature setpoints shall be scheduled as follows:

	Room Setpoint Temperature	**Room-Level Adjustable Range**
Compounding and Ante Rooms	Less than or equal to 20°C	18.0°C - 20.0°C
HD Storage	Less than or equal to 25°C	20.0°C - 25.0°C
Staging Area and Store Room	22°C	20.0°C - 24.0°C

1.5 Room Monitoring Requirements

.1 All project areas require continuous monitoring of room temperature and relative humidity with DDC graphics to display these parameters.

.2 Provide continuous monitoring of relative pressurization for ISO rated rooms.
.1 Pressure is measured among ISO & non ISO rated spaces.
.2 Provide an on-wall local display at each ISO rated spaces to display space temperature, relative humidity, relative pressurization and room mode with graphics at DDC system.
.3 Provide multi-variable touch display at storeroom to monitor each room. Parameters include space temperature, relative humidity, relative pressurization and room mode.

1.6 BSC Cabinet Exhaust Fan (EF-2)

.1 EF-2 provides exhaust to the BSC cabinet at compounding room.
.2 Fans shall be enabled and disabled on the DDC schedule, shall run continuously.
.3 Fans interlock with BSC cabinet via fan relay contacts.
.4 Monitor fan status through BMS.

1.7 Pharmacy Exhaust Fan (EF-11)

.1 EF-11 provides exhaust to the pharmacy area.
.2 Fan shall be enabled and disabled on the DDC schedule, shall run continuously.
.3 Modulate the VFDs at the fan to maintain airflows and duct static pressure at the furthest ventrui valve.
.4 Monitor fan status through BMS.

1.8 Single Duct VAV Boxes (VAV-PS-004 and VAV-PR-004)

.1 Air terminal units shall be pressure independent, single duct VAV, complete with custom programmable application controllers.
.2 Occupancy state shall be determined by DDC schedule, or from the local temperature sensor.
.3 Occupied Operation (variable volume, constant temperature)
.1 Maintain space temperature setpoint by modulating the variable volume damper to increase flow rate to the maximum setting as needed to satisfy space temperature.
.4 Unoccupied Operation (variable volume, variable temperature)
.1 During unoccupied periods, supply and return air rates may be reduced to 60% of occupied conditions where advised by owner for energy savings.
.2 Upon call for cooling, the VAV shall modulate the variable volume damper to increase flow rate to the maximum setting as needed to satisfy space temperature.
.3 After the temperature has been satisfied, the flow rate will return to the minimum setting.
.4 Return VAV boxes shall modulate air flow proportionally between minimum and maximum setpoints in conjunction with supply units to maintain relative space pressurization.
.5 The DDC system shall provide monitoring and control for:
.1 Status/position
.2 Space temperature setpoint
.3 Actual space temperature
.4 Alarm monitoring

1.9 Ventrui Valve (VAV-PS-001 to 003 & VAV-PE-002 to 003)

.1 Air terminal units shall be pressure independent, complete with custom programmable application controllers.
.2 Occupancy state shall be determined by the local temperature and pressure sensors.
.3 Operation (constant volume, variable temperature)
.1 Maintain space temperature setpoint by modulating cooling coil (VAV-PS-001 only).
.2 Venturi valves shall modulate air flow proportionally between minimum and maximum setpoints in conjunction with supply units to maintain relative space pressurization at all time.
.4 The DDC system shall provide monitoring and control for:
.1 Status/position
.2 Space temperature setpoint
.3 Actual space temperature

.4 Alarm monitoring

1.10 Coiling Coil (CC-106)

.1 Provide new chilled water control valves. Modulate control valve to achieve air temperature setpoint.

END OF SECTION