PURCHASING SECTION
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ADDENDUM #3

REQUEST FOR QUOTATIONS (RFQ) NO.:	**1220-040-2016-121**
TITLE:	**GALLERY HVAC UPGRADE – SURREY ART GALLERY**
ADDENDUM ISSUE DATE:	**November 23, 2016**
CLOSING DATE:	**prefer to receive Quotations on or before:** **November 30, 2016**

INFORMATION FOR CONTRACTORS

This Addendum is issued to provide additional information to the RFQ for the above named project, to the extent referenced and shall become a part thereof. No consideration will be allowed for extras due to the Contractor not being familiar with this Addendum. This Addendum No. 3 contains 154 pages in total.

MECHANICAL:

Mechanical Specifications dated November 22, 2016 by The AME Consulting Group Ltd. is hereby added to the detailed scope of work as listed in Schedule B – Appendix 2 – Supplementary Specifications (Project). Refer to Attachment #1 of this Addendum #3 for the Mechanical Specifications.

Mechanical Addendum No. 1 dated November 21, 2016 by The AME Consulting Group Ltd. is hereby added to the detailed scope of work as listed in Schedule B – Appendix 2 – Supplementary Specifications (Project). Refer to Attachment #2 of this Addendum #3 for the Mechanical Addendum No. 1.

Mechanical Addendum No. 2 dated November 22, 2016 by The AME Consulting Group Ltd. is hereby added to the detailed scope of work as listed in Schedule B – Appendix 2 – Supplementary Specifications (Project). Refer to Attachment #3 of this Addendum #3 for the Mechanical Addendum No. 2.

ELECTRICAL:

Electrical Addendum No. 1 dated November 21, 2016 by AES Engineering Ltd. is hereby added to the detailed scope of work as listed in Schedule B – Appendix 2 – Supplementary Specifications (Project) and Schedule B – Appendix 2-A Contract Drawings (Project). Refer to Attachment #4 of this Addendum #3 for the Electrical Addendum No. 1.

QUESTIONS AND ANSWERS:

Q1: The new AHU's come with a shipped lose control panel. Who will be responsible for mounting of the panel?

A1: This will be the successful Contractor's responsibility.

Q2: Who will be responsible for interconnecting wiring between the panel and the unit?

A2: This will be the successful Contractor's responsibility.

Q3: Who will be responsible for interconnecting wiring between indoor and outdoor units?

A3: This will be the successful contractor's responsibility.

Q4: I have noticed that there will be 5 units on top of 4 existing roof curbs. We have made provisions to use HSS Structural Steel across all 4 curbs which will overhang about 6 ft on each end to accommodate all 5 units (as per mechanical drawings). Please confirm if that will be acceptable.

A4: There are 5 existing units. The replacements are one to one.

Q5: Will there be any addition of new roof curbs?

A5: No.

Q6: What is the line size for the steam and condensate lines from the engineer?

A6: Humidifier (electric) units shall have piping line sizes per manufacturer recommendation, noted per equipment schedule. Equipment cut sheets for specified units; with line sizes shown, are attached for reference.

END OF ADDENDUM #3

ATTACHMENT #1

to

ADDENDUM #3

MECHANICAL SPECIFICATIONS

SURREY ART GALLERY
HVAC UPGRADES

MECHANICAL SPECIFICATION
ISSUED FOR RFQ

PROJECT NO. 085B-047-16

November 22, 2016

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

AME Group
consulting mechanical engineers

Note: Contractor to provide separate price for Controls scope of work.

1. GENERAL

1.1 General

.1 The project will achieve or exceed following temperature, humidity and acoustical requirements:

.2 Commissioning and stabilization of HVAC function in museums: Environment standards for a Class A museum tolerate only a minimal variation of temperature and humidity over the course of 24 hours. Proof of stability is a requirement using these charts, by lenders such as the National Gallery of Canada for approval of artwork loans to the Surrey Art Gallery: Requirements for proving consistency are the paper hygrothermograph charts sourced from a number of machines placed throughout the Gallery's art handling/storage, exhibition and preparation spaces at the height of art storage and display.

.3 Temperature: should be set at a steady temperature within this range 18-24ºC and controlled with a variation no more than ±1ºC over 24 hours. The Gallery recommends 20C.

.4 Relative Humidity: 40-55% and should be set within this range and not vary more than the control value variation of ± 5% over 24 hours. The Gallery recommends 50%.

.5 New HVAC units meet CCI requirements for a Class A museum - Fluctuations must be within minimal tolerances over limited passages of time

.6 HVAC units operate to museum standard until scheduled removal - No fluctuations can occur while artwork is on display or in gallery art holding or prep areas

.7 HVAC units and air systems need to be very quiet as the Gallery presents audio art. - The HVAC needs to be almost silent

.8 Mechanical Contractor shall be acting as General Contractor for the Surrey Arts Centre HVAC Upgrades Project. Therefore following specification sections shall be read with that understanding. The mechanical contractor means, general contractor and mechanical contract means, contract. From electrical work prospective, all work is to be carried by Electrical Contractor (hired by Mechanical contractor, where mechanical contractor will act as General Contractor, as it has been stated already). Since design documents were not developed for electrical scope of work, electrical work is to be conducted strictly on "design build" basis. Upon all electrical work being completed, it is expected that electrical contractor mark-up (CAD format) all new work being completed on existing City Record drawings (record drawings to be provided by City).

1.2 Intent

.1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.3 Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Consultant in writing during the bidding period.

.4 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.5 Install equipment generally in locations and routes shown. Run piping close to building structure, parallel to building lines to maximize head room and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Engineer at no extra cost.

.6 Install equipment to provide access and ease of maintenance.

.7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test.

.8 Install control valves, thermal wells, and other devices on piping, furnished by Controls Contractor.

.9 Provide seismic restraints for all required equipment, piping.

.10 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Contractor shall, at his own expense, repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered.

.11 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.

.12 'Provide' shall mean 'supply and install'.

1.3 Coordination of Work

.1 Cooperate and coordinate with other trades on the project.

.2 Make reference to mechanical, existing electrical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

.3 Where dimensional details are required, work with the applicable existing architectural and structural drawings.

.4 Full size and detailed drawings shall take precedence over scale measurements from drawings. Drawings shall take precedence over specifications.

.5 Any areas indicated as space for future materials or equipment shall be left clear.

1.4 Permits

.1 All work shall comply with provincial, municipal, bylaws and authorities having jurisdiction.

.2 Obtain all permits and pay all fees applicable to the work.

.3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

.4 Contractor shall provide schedule B1/B2 letters of assurance for seismic engineering.

1.5 RFQ Price Breakdown

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

.2 As a minimum, include the following in the RFQ price breakdown:

.1 Mechanical: Equipment, materials, labour

.2 Plumbing: Equipment, materials, labour

.3 Controls: Equipment, materials, labour

1.6 Progress Claims

.1 Submit a Progress Summary and a Detailed Price Breakdown with each Progress Claim. The Summary and Breakdown shall include all Change Orders issued.

.2 Progress claims shall not be processed past 95% of the overall Mechanical Contract until the final commissioning has been completed. This will allow for sufficient deficiency holdbacks for problems identified during commissioning.

1.7 Examination of Site

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

1.8 Quality of Work

.1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Consultant.

.2 Work which does not conform to standards accepted by the Consultant and the trade may be rejected by the Consultant. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

1.9 Metric Conversion

.1 All units in this division are expressed in SI units.

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.

.4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:

.1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.

.2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

EQUIVALENT NOMINAL DIAMETER OF PIPES

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

1.10 Alternate Materials and Equipment

.1 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List. If no acceptable manufacturer has been listed, refer to approved equivalents below.

.2 Requests for approval for RFQ purposes of equivalent materials or equipment shall be submitted to the Consultant no later than seven (7) working days prior to the closing date of RFQ for mechanical trade, complete with all applicable technical data, including performance curves and physical details. Approval of requests shall only be given by addendum.

.3 The Contractor shall, in his quotation, indicate the degree of approval obtained from the Consultant. In the event that the product has been approved as "Alternate Only", this shall be stated in the quotation, and the contractor shall bear any and all costs for design/system modifications to accommodate the “alternate” equipment..

.4 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.

.5 The Contractor shall be fully responsible for any additional work or materials required by the trades or other Contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

1.11 Drawings and Specifications

.1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.

.2 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain a ruling from the Consultant, before submitting a RFQ. If this is not done, it will be assumed that the most expensive alternate had been included.

.3 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out without changes to building.

1.12 Shop Drawings

.1 Provide 4 copies, for all scheduled equipment and as specified in specific equipment sections of this specification.

.2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalog material. Do not assume applicable catalogues are available in the Consultant’s office. Maintenance and operating manuals are not suitable submittal material.

.3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.

.4 Include weights, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes. Provide centre of gravity diagrams for the use of the seismic consultant.

.5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Consultant.

.6 Do not order equipment or material until the Consultant has reviewed and returned shop drawings.

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

.8 Retain one copy of shop drawings on site for review.

1.13 Salvage

.1 Remove from site all equipment, or piping which is no longer required because of work under this Contract.

.2 Turnover to and deliver to the Owner's storage area all items which have been determined to have salvage value and has been removed due to the Work.

1.14 Cutting, Patching and Coring

.1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the City of Surrey Structural Consultant before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes *100 mm* or larger in diameter. Field-cut smaller than *100 mm.*

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.15 Installation of Equipment

.1 Pipe all equipment drains to building drains.

.2 Unions and flanges shall be provided in piping to permit easy removal of equipment.

.3 Maintain permanent access to equipment for maintenance.

1.16 Fire-Stopping

.1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The contractor is required to coordinate with the existing architectural drawings to contractual rated wall types and installation details.

.2 Fire-stopping materials to meet ULC CAN 2S115. Acceptable Materials: by "Tremco" or "National Firestopping", "Hilti", "3-M".

.3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

1.17 Connections to Existing Services

.1 Maintain liaison with the Owner and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of 48 hours notice for all service shutdown.

.3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

1.18 Equipment and Materials

.1 Materials and equipment installed shall be new, full weight and of quality specified.

.2 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.

.3 Where two or more products of the same type are required, products shall be of the same manufacturer.

.4 Make known in writing to the Engineer ten (10) days prior to the RFQ closing date any materials specified that are required to complete the work which are not currently available or will not be available for use as called for herein. Failing to do so, it will be assumed that the most expensive alternate has been included in the RFQ price.

.5 All equipment supplied to the project will meet efficiencies as defined in ASHRAE Standard 90.1 2004.

1.19 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.20 Electrical Motors

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drive (variance frequency drive) shall be inverter only rated.

.3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.

.4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.

.5 Motors less than 1-hp shall be 120 V, 60 Hz, 1 phase. Motors 1-hp and larger shall be 3 phase at the indicated voltage.

.6 All motors shall be 1800 rpm where indicated.

.7 Provide motors with complete except where indicated.

.8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.

.9 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.

.10 Refer to electrical specifications, Division 16, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 15.

.11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.

.12 Minimum certified motor efficiency shall be as outlined in ASHRAE 90.1 2004.

Minimum Nominal Full-Load Efficiency (%)

	Open Motors			Enclosed Motors		
Number of Poles	2	4	6	2	4	6
Synchronous Speed (RPM)	3600	1800	1200	3600	1800	1200
1	-	82.5	80.0	72.5	82.5	80.0
1.5	82.5	84.0	84.0	82.5	84.0	85.5
2	84.0	84.0	85.5	84.0	84.0	86.5
3	84.0	86.5	85.5	85.5	87.5	87.5
5	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	88.5	89.5	89.5
10	88.5	89.5	90.2	89.5	89.5	89.5
15	89.5	91.0	90.2	90.2	91.0	90.2
20	90.2	91.0	91.0	90.2	91.0	90.2
25	91.0	91.7	91.7	91.0	92.4	91.7
30	91.0	92.4	92.4	91.0	92.4	91.7
40	91.7	93.0	93.0	91.7	93.0	93.0
50	92.4	93.0	93.0	92.4	93.0	93.0
60	93.0	93.6	93.6	93.0	93.6	93.6
75	93.0	94.1	93.6	93.0	94.1	93.6
100	93.0	94.1	94.1	93.6	94.5	94.1
125	93.6	94.5	94.1	94.5	94.5	94.1
150	93.6	95.0	94.5	94.5	95.0	95.0
200	94.5	95.0	94.5	95.0	95.0	95.0

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

1.21 Miscellaneous Metals

.1 Provide all necessary miscellaneous to hang or support materials, equipment and provide access for work under this contract.

.2 All miscellaneous metals shall be prime painted.

.3 Miscellaneous metals shall include but not limited to:

.1 Hangers for equipment, piping.

.2 Support for equipment.

.3 Access platforms and catwalks.

1.22 Pipe Sleeves

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

.2 Schedule 40 steel pipe shall be used as floor pipe sleeves in wet areas with a *50 mm* up-stand.

.3 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

1.23 Escutcheon and Plates

.1 Provide escutcheon and plates on piping passing through finished walls, floors and ceilings.

.2 Escutcheons shall be split type, stainless or chrome plated steel.

1.24 Painting and Identification

.1 Colour code mechanical equipment, piping and exposed ductwork. Refer to colour schedule at end of this section.

.2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum *20 mm* high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.

.3 Identify piping with labels, colour bands, and flow arrows. Provide identification at *15 m* maximum intervals, before and after pipes pass through walls, at all sides of tees, behind in equipment rooms as required.

.4 Apply colour bands at both ends of the label with primary colour bands used to secure both ends of individual labels. Refer to colour schedule at end of this section.

.5 Provide *20 mm* diameter brass, with metal photo black numbers, or white lamacoid with black engraved numbers, secured to valve stem with key chain.

.6 Provide neat, typewritten directories, giving valve number, services and location. Frame one copy under glass for wall mounting as directed, second copy to be forwarded to Owner. Include copies in O & M Manuals.

.7 Tag automatic controls, instruments and relays and match/key to control shop drawing identification numbers. Tag all equipment and control panels.

.8 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplied under this division with lamacoid plates having *6 mm* minimum letter size. Identification to state equipment controlled.

1.25 Colour Coding Schedule

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

MECHANICAL PRIMARY COLOURS FOR PIPE LINES/EQUIPMENT

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

SECONDARY COLOURS FOR BANDS

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

BANDING

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

.2 Identification Symbols and Colour for Piping

	Pipe Colour	Stripe Colour	Symbol
Chemical Feed Line	Green	Orange	Chem.Symb. ($S0_3$)($P0_4$)
Chilled Water Ret.	Green	Orange	Ch.Wat.R.
Chilled Water Supp.	Green	Orange	Ch.Wat.S
Compressed Air	White	None	kPa Air
Condensate	Green	Orange	Cond.
Cooling Water Ret.	Green	Orange	Cool Wat.R.
Cooling Water Supp.	Green	Orange	Cool Wat.S
Domestic Cold Water	Light Blue	None	Dom. Cold Wat.
Domestic Hot Water	Green	Orange	Dom. Hot Wat.
Domestic Hot Water	Green	Blue	Dom.Hot Wat.R.
Drains	Aluminum	Red/Orange	Drain
Drinking Water	Light Blue	None	None
Glycol Return	Green	Orange	Glycols R.
Glycol Supply	Green	Orange	GlycolS
Heating Hot Water Return	Yellow	Orange	Heat Wat.R.
Heating Hot Water Supp.	Yellow	Red	Heat Wat.
Natural Gas	Orange	Red	Nat.Gas
Sprinkler	Red	None	Sprinkler
Stand Pipe (Dry)	Red	None	Dry Stand Pipe
Stand Pipe (Wet)	Red	None	Stand Pipe
Vent	Aluminum	Red/Orange	Vent
Water Boiler Feed	Green	Orange	Blr.Feed (Under *120ºC*)
Water Non-Potable	Light Blue	Red	NPW

.3 Identification Symbols and Colours for Equipment:

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

	Pipe Colour	Stripe Colour	Symbol
Valves Uninsulated	High Heat Aluminum		

.4 Mechanical Control Systems

.1 Conduit pull boxes, terminal boxes and junction boxes - GREY Covers - GREY with black `C'.

.2 Main and secondary control panels, factory finish acceptable - control Contractor to install company label to identify.

1.26 Temporary or Trial Usage

.1 Temporary or trial usage by the Owner or Consultant of mechanical equipment supplied under contract shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

.3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.4 Avoid thermal shock to heating system by co-ordination with the Owner during planning, construction and operation of temporary heating system.

.5 Return condensate to the heating plant. Meter equipment is not required.

1.27 Substantial and Total Performance

.1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items which are deficient.

.2 A certificate of Substantial Performance will not be granted unless the following items are completed:

.1 Heating, plumbing systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the contractor to have a substantial completion inspection.

.2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.

.3 Water systems have been balanced with draft report submitted to Engineer.

.4 Valve tagging and equipment identification is complete.

.5 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.

.6 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.

.7 Draft Operating/Maintenance Manuals have been submitted.

.8 Operating and Maintenance demonstrations have been provided to the Owner.

.9 Written inspection report by manufacturer’s representative has been submitted for noise and vibration control devices and flexible connections.

.10 Record drawings have been submitted.

.11 All seismic restraint devices have been installed.

.12 All previously identified deficiencies have been corrected.

.3 The following shall be an outline checklist of the minimum requirements to be met by the contractor prior to the Consultants' Substantial Performance by the contractor.
Inspection:

.1 Complete Commissioning Checklists

.2 Final Plumbing Inspection Certificate from local plumbing inspector

.3 Controls Commissioning, Checklist and 15 day trend logs for all major equipment

.4 Seismic Engineers inspection of all Seismic restraints and schedule C letters of assurance

.5 Vibration isolation supplier's inspection report

.6 Final As-Built Drawings ready for review

.7 Maintenance and operation manuals, ready for review

.4 Prior to Total Performance Inspection provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:

.1 Submit final water balance reports.

.2 Submit final operating and maintenance manuals.

.3 Complete final calibration.

.5 The Consultant shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required, shall be at the expense of the Contractor.

.6 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

1.28 Acceptable Manufacturers

.1 The following listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.

.2 It remains the responsibility of the contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.

.3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers list.

.4 Submit within 10 days of contract award a copy of the list underlining the name of the manufacturer whose price was carried in the RFQ. If no manufacturers names are submitted, it will be assumed that the price carried in the RFQ was that of the specified manufacturer or where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.

.5 List of acceptable Manufacturers:

• Air Separators, Relief Valves	Armstrong, Bell & Gossett, Taco, Wheatley
• Air Vents	Hoffman, Maid-O-Mist, Taco
• Backflow Preventers	Febco, Watts, Hersey, Singer, Ames
• Balancing Agents	KD Engineering
• Boilers – Condensing	De-Dietrich

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

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

2. PRODUCTS

3. EXECUTION

.1 Not Applicable.

END OF SECTION

1. GENERAL

1.1 Intent

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

1.2 Reference Standards

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

1.3 Existing Conditions

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

1.4 Protection

.1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement, and any damage or injury caused.

.2 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work of this Section.

.3 Prevent debris from blocking surface drainage inlets and all types of drainage piping systems which remain in operation.

1.5 Salvageable Materials

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

2. EXECUTION

2.1 Existing Services

.1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction. Natural gas supply lines shall be removed by the gas company or by a qualified tradesman in accordance with gas company instructions.

.2 Building Mechanical Services: Maintain all building services during demolition/removal of existing.

.3 Maintain all trap seals and ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

2.2 Demolition

.1 Completely demolish the items scheduled and remove all materials from the premises.

.2 Carry out demolition in a manner to cause as little inconvenience to the occupied building area as possible. Co-ordinate this activity with the Owner and/or the Consultant.

.3 Carry out demolition in an orderly and careful manner.

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

2.3 Asbestos Insulated Piping and Equipment

.1 When new work is required to be connected to existing plumbing and piping or equipment which contains asbestos insulation or products the following shall apply:

.1 Keep disruption to existing piping and equipment to a minimum

.2 Protect the site and all Contractors from the work.

.3 Remove the asbestos at piping and equipment for new connections and carry out work in accordance with WCB requirements for asbestos removal.

2.4 Core Drilling/Sleeving Through Existing Structure

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 Operating and Maintenance Manuals.

.2 Record Drawings.

1.2 Quality Assurance

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

2. PRODUCTS

2.1 Operating and Maintenance Manuals

.1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Consultant two (2) months prior to final inspection.

.2 Provide four (4) *216 mm x 280 mm* ***8.5 in. x 11 in.*** capacity, expanding spine catalogue binders, bound with heavy fabric, hot stamped lettering front and spine.

.3 Index binder according to the following system:

Tab-1.0 Mechanical Systems:

Title page with clear plastic protection cover.

Tab-1.1 List of Mechanical Drawings:

Tab-1.2 System Descriptions:

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

Tab-1.3 Operating Division:

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

Tab-1.4 Maintenance and Lubrication Division:

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

Tab-1.5 List of Equipment Suppliers and Contractors:

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

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

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

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

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

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

2.2 Record Drawings

.1 Refer to Division 1.

.2 The Contractor shall keep on site, available to the Consultant at all times and particularly for each regularly scheduled site meeting, a complete set of prints, edge bound, that are to be updated daily showing any and all deviations and changes from the Contract Drawings. This set of drawings is to be used only for this purpose, and must not be used as the daily general reference set.

.3 Provide record drawings which identify location of dampers, access doors, tagged valves, and actual room names or numbers. As well, deviations that are to be recorded shall include in general, items that are significant or are hidden from view and items of major importance to future operations and maintenance, and to future alterations and additions including cleanouts and isolation valves.

3. EXECUTION

3.1 General

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

3.2 Record Drawings

.1 Indicate real configuration of all services part of this project.

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

END OF SECTION

1. GENERAL

.1 The project will achieve or exceed following temperature, humidity and acoustical requirements:

.2 Commissioning and stabilization of HVAC function in museums: Environment standards for a Class A museum tolerate only a minimal variation of temperature and humidity over the course of 24 hours. Proof of stability is a requirement using these charts, by lenders such as the National Gallery of Canada for approval of artwork loans to the Surrey Art Gallery: Requirements for proving consistency are the paper hygrothermograph charts sourced from a number of machines placed throughout the Gallery's art handling/storage, exhibition and preparation spaces at the height of art storage and display.

.3 Temperature: should be set at a steady temperature within this range 18-24ºC and controlled with a variation no more than ±1ºC over 24 hours. The Gallery recommends 20C.

.4 Relative Humidity: 40-55% and should be set within this range and not vary more than the control value variation of ± 5% over 24 hours. The Gallery recommends 50%.

.5 New HVAC units meet CCI requirements for a Class A museum - Fluctuations must be within minimal tolerances over limited passages of time.

.6 HVAC units operate to museum standard until scheduled removal - No fluctuations can occur while artwork is on display or in gallery art holding or prep areas.

.7 HVAC units and air systems need to be very quiet as the Gallery presents audio art. - The HVAC needs to be almost silent.

1.2 General

.1 This section describes the commissioning of the mechanical system and outlines the duties and responsibilities of the team.

.2 The commissioning of the mechanical system shall be in accordance with the Code of Practice for Commissioning Mechanical Systems in Buildings and as described in this section.

.3 The commissioning process shall be applied to all products, equipment and systems provided under this Division.

.4 Work specified in this section shall be performed by *an independent Agency specializing in this type of work and paid by the Contractor.

.5 The Commissioning Agency shall appoint a Commissioning Coordinator upon award of contract.

.6 Acceptable Agencies: K.D. Engineering, Western Mechanical, Airmec Systems Ltd.

.7 Where the owner engages his own commissioning agent, the following specifications are to be used as a guide by the contractor to allow and include for the necessary coordination with the commissioning agent.

1.3 Scope

.1 Demonstration of equipment and systems operations.

.2 Instruction seminars for Owner's personnel.

.3 System start-up, testing and operational checking.

1.4 Quality Assurance

.1 Work specified shall be performed by *an Independent Agency specializing in this type of work, *the Contractor.

.2 The commissioning process shall be consistent with the "Code of Practice for Commissioning Mechanical Systems in Buildings".

.3 Within (20) twenty days of the award of the General Contract, supply the name, qualifications, and experience of the commissioning co-ordinator for the review and approval of the Consultant.

1.5 Approved Manufacturers

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

2. THE COMMISSIONING PROCESS

2.1 The Commissioning Team

.1 The Commissioning Team shall be formed and consist of:

.1 The Commissioning Agent.

.2 The Consultant’s representative.

.3 The Owner's staff representative.

2.2 Duties of the Team

.1 The duties of the team are summarized below:

.1 The Commissioning Coordinator shall plan, organize and implement the commissioning process and shall within one month of the award of the contract submit the name and address of the commissioning co-ordinator.

.2 The Commissioning Coordinator shall provide a complete description of the systems operation, performance and flow data to the Consultant for review.

.3 The Commissioning Coordinator shall prepare the commissioning plan and provide demonstration and instructions to the Owner's staff over a period of time to enable the staff to become familiar with the systems.

.4 Where the owner appoints a commissioning agent, the contractor shall include and provide for complete cooperation and all work necessary to assist the commissioning agent in the completion of the work, as outlined in this section.

2.3 Commissioning Schedule

.1 Within [three (3)] months of commencing with the project work the commissioning coordinator shall review design intent and intended commissioning procedures with the Engineer. [Six months] prior to the date of scheduled substantial performance submit a detailed plan identifying the orderly progression of the prestart commissioning check and subsequent commissioning performance check of each sub-system, leading up to the ultimate commissioning of entire systems.

.2 Submit a schedule for the commissioning phase of the work. This schedule shall show:

.1 Completion dates for each trade in each major section of the building.

.2 Timing of the various phases of the commissioning, testing, balancing and demonstration process.

.3 Submission dates for the various documents required prior to verification of commissioning by the Consultant.

.4 Prepare a commissioning statement in which each of the four (4) phases that the process is perceived to be worked through. In sequence, the phases are expected to be:

.1 Phase 1 - System Readiness.

.2 Phase 2 - System Start-Up, Testing, Balancing, Etc.

.3 Phase 3 - Verification of System Commissioning.

.4 Phase 4 - Demonstration and Instruction.

.3 With the commissioning schedule noted above, submit a copy of all commissioning worksheets to be used during the commissioning process.

.4 Each phase is applicable to each major and separate system making up the work in Division 15 including controls and Division 16 interface as applicable.

.5 Where an owner appointed commissioning agent is part of the construction tem, the contractor shall allow for the scheduling based on the above outline.

2.4 Commissioning Phases

.1 Phase 1 - Before starting any of the separate systems, provide written verification stating that the specific system is ready for start-up and the following conditions have been met:

.1 Copies of all test and certificates have been submitted to the Consultant.

.2 All safety controls installed and fully operational (dry run test).

.3 Flushing, chemical cleaning (as required), charging, fluid operating (as required), are complete.

.4 Equipment lubrication and pre-start checks are complete.

.5 Control functional checks, including all alarms performed.

.6 Start-up verification checks by manufacturers' representatives completed.

.7 All deficiencies to be recorded, reviewed by the commissioning team and, subsequently corrected before proceeding to the next phase, Phase 2.

.2 Phase 2 - System Commissioning shall include but not necessarily be limited to:

.1 Activation of all systems.

.2 Testing and adjustment of all systems.

.3 As in the case of the System Readiness Phase, all deficiencies are to be recorded, reviewed by the Commissioning team and, subsequently, corrected. The process at the point of the deficiency shall be repeated before proceeding forward.

.4 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:

.1 Position all balance valves in piping systems (where appropriate).

.2 Set up all automatic temperature control devices.

.3 Adjust vibration isolators and earthquake restraints as necessary.

.4 Water balance complete.

.5 Fine Tuning:

.1 Setting up automatic controls for accurate response and precise sequencing.

.2 Correction of problems revealed by Balancing Agency and change of fan speed and pitch as necessary.

.6 Testing:

.1 The commissioning coordinator shall perform a detailed check of the following:

.1 All items and functions to be later demonstrated to the Owners representatives.

.2 Systems operation in the fire mode (pressurization and smoke removal) in the presence of the authorities having jurisdiction. Obtain a written statement/ certificate of approval from the authorized manual jurisdiction.

.3 Phase 3 - Verification of Commissioning.

.1 Verification of commissioning by the Consultant shall not commence until the commissioning process, Phase 2, has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:

.1 Location of and opening and closing of all access panels.

.2 Operation of all automatic control valves and automatic temperature/volume adjustment controls.

.3 Operation of all equipment and systems, under each mode of operation, including:

.1 D.D.C. control features.

.2 Automatic controls.

.3 Humidifiers (electric)

.4 Air Conditioning & Condenser Units

.5 Control Valves

.2 At the completion of Phase 3, the Contractor shall submit the following to the Consultant:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

.2 A copy of Phase 2 Verification Certificates provided by the specialist trades for submission to the Consultant.

.3 Record drawings as specified.

.4 A letter from the testing and balancing agency certifying that all necessary data for inclusion in operating and maintenance manuals has been received.

.5 A statement confirming completion of EMCS acceptance test, Section 15900.

.3 Upon receipt of all documents and a satisfactory outcome of the verification procedure, the Consultant will provide a Certificate of Verification for Phase 3.

.4 Substantial Performance may, thereupon, be declared.

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

3. EXECUTION

.1 The following systems are to be commissioned:

3.2 HVAC Systems

.1 Humidifiers (electric) - check out by manufacturer's representative, water piping connections, and controls.

.2 Air Conditioning & Condenser Units - Installation insulation, identification, piping connections, and controls

.3 Piping System - pressure tests, insulation, identification, water balance, hangers, expansion, and earthquake restraints.

.4 Control Valves - Installation, controls, capacity modulation, connection to EMCS, identification.

.5 Controls

3.3 Earthquake Restraints

.1 Ducts, piping, equipment.

3.4 General

.1 Independent Agency shall chair the demonstration and instruction sessions.

.2 Contractor shall arrange for presentation and demonstration of mechanical equipment and systems by appropriate specialists and shall ensure that required manufacturer's representatives are in attendance.

3.5 Demonstrations

.1 Demonstrate specific starting and general maintenance requirements for each major piece of equipment. Ensure all labeling and identification is completed.

.2 Demonstrate the following systems, in the form of instruction seminars and contractor-guided tour of the facility.

.1 Heating / Cooling Systems;

.2 Control Systems;

.3 Demonstrate the following pieces of equipment:

.1 Humidifiers

.2 Air Conditioning & Condenser Units

.4 Prepare a schedule identifying the proposed sequence of demonstration. Sequence of demonstration shall correspond to full system starting. Submit for review by Engineer one month prior to demonstration.

.5 Answer all questions raised by Owner at demonstrations; if unable to satisfactorily answer questions immediately, provide written response within three (3) days.

.6 Provide a professionally produced video of all instructions and demonstrations. Engage the services of a professional video production company to provide four (4) copies of the edited video tape(s).

END OF SECTION

1. GENERAL

1.1 Scope

.1 Balance, adjust, and test air, and water systems and equipment and submit reports in identical units to those shown on contract documents.

.2 Obtain sound level reading and submit reports.

.3 Co-operate with the commissioning process.

.4 Contractor shall prepare the facility for balancing.

1.2 Quality Assurance

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

.2 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed 5 projects of similar size and scope.

.3 Provide extended warranty of 90 days after completion of test and balance work. During this period the Consultant may request re-check, or resetting of outlets or fans as listed in test reports. Provide technicians and instruments required.

.4 Begin testing and balancing after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of testing and balancing.

.5 This agency shall remove and re-install ceiling tile to provide access to ductwork and piping. The balancing Contractor will make good any damage or soiling caused by his forces.

.6 Carry out testing, adjusting and demonstrating of work prior to takeover by the owners.

.7 Have all work performed solely by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review of the Consultant prior to work being carried out.

.8 Witnessing of all tests by the Consultant and/or owner shall be at their option. Advise the consultant and/or owner of the time and location of tests.

.9 Test records of all manufactured equipment shall be complete with a manufacturer's affidavit.

.10 Have all records signed for accuracy by all witnesses and forward to consultant for review.

.11 Bind a complete set of test records in each Owner's manual issued, and note those records for which tests have been witnessed by Authorities having jurisdiction.

.12 Perform spot checks as requested by the Consultant.

.13 Balancing procedures shall be in accordance with the latest, current requirements NEBB, SMACNA and ASHRAE Standards.

1.3 Approved Agencies

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

1.4 Site Visits

.1 Minimum of 3 site visits shall be made during construction to correspond with the general monthly site meetings held by the Contractor. After each site visit, a written report shall be submitted to the Contractor and Consultant. Site visits shall commence after the start of air and water distribution work and be spread over the construction period to the start of the balancing work.

.2 A review of the installation shall be made at the specified site visit and any additional dampers or valves required for proper balance shall be reviewed with the Consultant and the Contractors.

.3 Allow 2 visits to site to adjust systems for seasonal changes and to check and reset fans and outlets during warranty. Coordinate time of visit with the Owner. Submit reports to Consultant.

.4 Begin balancing after balancing preparation and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.5 Balancing Agenda

.1 General: Submit balancing agenda to the Consultant and commissioning contractor for review at least 7 days prior to the start of balancing work. Start balancing work after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.

.3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.4 Sample Forms: Form showing application of procedures to typical systems.

1.6 Balance Report

.1 Submit two (2) copies of balancing reports to Consultant prior to final acceptance of project.

.2 Provide four (4) copies of final reports to Contractor for inserting in owner's Operating and Maintenance Manuals as described in Section 15015 Documentation.

.3 Include types, serial number and dates of calibration of instruments in the reports.

1.7 System Data

.1 The following information shall be provided:

.1 **Air Handling Equipment**

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

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

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

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

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

.3 **Air Inlet and Outlets**

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

Humidifiers

Design Data:

Motor kW (Hp), r/min, amps, volts, phase;
Heat transfer capacity;
Fluid min/max Pressures;
Entering and leaving fluid temperatures;
Fluid pressure drop.
Total air flow rate;
System static pressure;
Inlet and outlet, dry and wet bulb temperatures.

Installation Data:
Manufacturer, model, type;
Motor type, kW (Hp), r/min, voltage, phase, cycles, and load amperage;
Location and local identification data.
Capacity;
Pressure drops;
Flow rates.
Fluid min/max Pressures;
Entering and leaving fluid temperatures;

Recorded Data:
Element type and identification (location and designation);
Inlet and outlet, dry and wet bulb temperatures (for varying outdoor temperatures);
Entering and leaving fluid temp (for varying outdoor temperatures);
Fluid pressure drop;
Fluid flow rate;
Motor operating amperage;.

1.8 Acceptable Manufactures

.1 Balancing Agents

.1 KD Engineering, Western Mechanical Systems

1.9 Instruments

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

2. EXECUTION

2.1 General Procedure

.1 Permanently mark, by stick-on labels, settings on valves, splitters, dampers, and other adjustment devices.

.2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Balancing shall be performed to the following accuracies:

• Air	terminal outlets	±10%
• Air	central equipment	±5%
• Hydronic	terminal outlets	±10%
• Hydronic	pumps and central	±5%

2.2 Air System Procedure

.1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

- Ensure dampers or volume control devices are in fully open position.
- Balance central apparatus to ±10% air flow.
- Balance branches, mains to ±10% air flow.
- Recheck central apparatus.
- Balance all terminal air outlets to ±10%.
- Rebalance central apparatus to ±5%.
- Recheck all air outlets.
- Perform acoustical measurements.
- Perform building pressurization tests and measurements at minimum and maximum outdoor air damper positions of the main air unit(s).

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.4 Take static pressure readings and air supply temperature readings at 20 points on each air system.

.5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. If readings are inconsistent across duct, relocate to two duct *diameters *widths and re-do traverse.

.6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.8 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

.9 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. Full multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.10 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of *10 Pa* ***(0.04 in.w.g.)*** minimum and *20 Pa* ***(0.08 in.w.g.)*** maximum shall be achieved, measured with negligible outside wind velocity.

2.3 Balancing of Hydronic Systems

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

.2 Set pumps to deliver 10% excess flow if possible.

.3 Adjust flows through each boiler to ensure equal flow.

.4 Check and adjust flows and temperatures at inlet side of coils.

.5 Position and mark all automatic valves, hand valves and balancing cocks for design flow through all coils, connectors and all items in system requiring circulation of chilled water, hot water or glycol.

.6 Upon completion of flow readings and coil adjustments, mark setting and record data.

.7 Coordinate shaving of impellor to operating condition on pumps larger than *1.5 kW.* ***(2 Hp)***.

.8 Ensure all bypass valves are tightly closed.

.9 After making all terminal unit adjustments, re-check settings at pumps. Re-adjust as required.

.10 Calibrate all pressure and temperature gauges.

.11 Install pressure gauges on each coil then read pressure drop through coil and set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop.

.12 For each pump, plot maximum and minimum flows on curve.

.13 Verify pressure drops and flows through pressure control bypass valves at full operating range.

2.4 Balancing Report

.1 Submit draft copies of reports prior to final acceptance of project.

.2 Include types, serial number and dates of calibration of instruments.

.3 Record test data on a sepia made from the latest available revised set of mechanical drawings and submit four (4) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

.4 Install at each piece of mechanical equipment a "Data Register" showing significant operating temperatures, pressures, amperes, voltage, brake horsepower. "Data Register" to be enclosed in a plastic holder securely attached to the equipment or to a wall in the adjacent area.

.5 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

.6 Report shall be indexed as follows:

Instrumentation
Summary
Procedure
Instrumentation
Drawings
Equipment Data

Element Data Summary and Schematics (per system)
Diagnostic

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

.1 Verify lubrication of equipment.

.2 Install permanent instrumentation.

.3 Complete the "start-up" of equipment.

.4 Check rotation and alignment of rotating equipment and tension of belted drives.

.5 Verify ratings of overload heaters in motor starters.

.6 Set control points of automatic apparatus, check-out sequence of operation.

.7 Make available control diagrams and sequence of operation.

.8 Clean work, remove temporary tags, stickers, and coverings.

.9 Make available one (1) copy of Maintenance Manuals especially for use in balancing.

.10 Provide Balancing Agency a complete set of mechanical drawings and specifications.

2.6 Cooperate with the Balancing Agency as follows:

.1 Make corrections as required by Balancing Agency.

.2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings for their use.

.3 Operate automatic control system and verify set points during balancing.

2.7 Balancing Valves

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 Test heating water piping.

.2 Manufacturer's startup of equipment.

1.2 Quality Assurance

.1 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

.2 Test procedures in accordance with the current applicable portions of ASME, ASHRAE, and other recognized test codes as far as field conditions permit.

.3 Perform tests on site to the satisfaction of the Consultant.

.4 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Engineer. Provide ample written notice (two working days) to the Consultant before tests.

.5 Coordinate with Consultant at start of project, those tests that will require witnessing by the Consultant.

.6 Use factory trained representatives and submit manufacturer's check sheets for starting the following specialty equipment.

.1 Air Conditioning & Condenser Units

.2 Humidifiers

.3 Control components

.7 Prior to starting, testing, balancing, adjusting and cleaning processes, verify with Engineer any tests required to be witnessed. Provide sufficient notice to Engineer prior to commencement of procedures.

.8 Engineer shall be allowed to witness any testing, adjusting, starting, balancing and cleaning procedures.

.9 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.

.10 Prior to starting equipment or systems, secure and review manufacturer's installation, operation and starting instructions. Read in conjunction with procedures defined herein.

.11 Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.

.12 Compare installations to published manufacturer's data and record discrepancies. Items proving detrimental to equipment performance shall be corrected prior to equipment starting.

.13 Some processes involved in starting procedures defined in this section may be duplications of authorities' verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures. (Gas inspectors, boiler and pressure vessels inspections etc.)

.14 All starting, testing procedures shall be in accordance with applicable portions of the latest, current ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM and ASPE codes and standards.

.15 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the reading and tests.

.16 Assume all liabilities associated with starting, testing and balancing procedures.

1.3 Submittals

.1 Obtain certificates of approval, acceptance, and comply with current rules and regulations from authorities having jurisdiction and include in Operating and Maintenance Manuals.

.2 Perform tests as specified and upon completion of mechanical installation. Provide certification of tests with detailed data as required. Itemize each test as to time performed and personnel responsible. Include in Operating and Maintenance Manuals.

1.4 Liability

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

2. PRODUCTS

Not Applicable.

3. EXECUTION

3.1 Pressure Tests

.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

.2 Carry out tests for eight-hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.

.3 Water Piping: Test to 1-1/2 times maximum working pressure or *1033 kPa* ***(150 psi)***, whichever is greater, water pressure measured at system low point.

.4 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.

.5 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints and offsets for proper clearance.

.6 When using water as test medium for system not using water, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.

.7 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

3.2 Radiographic Examination of Welded Joints

.1 A minimum of 10% of the welded joints unless otherwise specified elsewhere, selected by the Consultant shall be examined by radiography, at Contractor's expense, as specified below.

.2 Pipe joints selected for examination shall be 100% radiographed.

.3 Examination method shall be as per current edition of ASME Code Section V, Article 2.

.4 Acceptance Criteria shall be as per current edition of ASME Code Section VIII Par UW-51. The standard of weld quality shall meet the applicable current Standard ANSI/ASME B31.1.

.5 Where a radiograph discloses defects, two additional joints shall be examined. The cost of additional radiography and the cost of repairs shall be borne by the Contractor.

3.3 Testing of Soldered Copper Joints

.1 Submit two (2) sample soldered copper pipe joints prepared by each tradesmen to be used on the project, to the Consultant within two (2) months of contract award. These samples may be subjected to radiographic testing to verify quality of workmanship.

.2 Remove ten (10) samples of soldered copper pipe joints on heating system during construction as selected by the Consultant and remake joints removed. Arrange and pay for radiographic testing of removed joints to verify quality of workmanship.

.3 Rejection of a sample will require re-test of adjacent joints at the Contractor's expense.

.4 Failure of more than 75% of the above removed samples will necessitate removal and replacement of all joints completed up to the time of test, at Contractor's expense.

3.4 General

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Meet with Division 16 manufacturers, suppliers, and other specialists as required to ensure all phases of work are properly coordinated prior to the commencement of each particular testing procedure. Establish all necessary manpower requirements.

.3 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.4 Confirm voltages and operating amperages at full load.

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

3.5 Procedures

.1 Procedures shall be identified in the following five (5) distinct phases:

.1 Pre-Starting: Visual inspection.

.2 Starting: Actual starting procedure.

.3 Post-Starting: Operational testing adjusting or balancing, and equipment run-in phase.

.4 Pre-Interim Acceptance of the Work: Final cleaning, re-testing, balancing and adjusting, and necessary maintenance.

.5 Post-Interim Acceptance of the Work: Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.

.2 Check specified and shop drawing data against installed data.

.3 Check the installation is as defined by contract documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

END OF SECTION

1. GENERAL

1.1 Scope

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

1.2 Related Work

.1 Catwalks, stairs and ladders.

.2 Steel supports for piping, ductwork and equipment.

.3 Gratings.

.4 Anchors and guides.

.5 Seismic supports.

.6 Checker plate covers and supports for mechanical shafts.

1.3 Quality Assurance

.1 Qualifications

.1 Welding to conform to design and procedure requirements of CSA Standard W59-1989 unless otherwise stated.

.2 All members or items subject to loading or stress shall be fabricated by an operator qualified under CSA Standard W47.1-1992.

.3 Structural or semi-structural members shall conform to CSA Standard S16.1-1994.

.4 Light gauge cold formed structural steel members shall conform to CSA Standard S136-1994.

1.4 Submittals

.1 Shops Drawings

.1 Submit shop drawings, to the Consultant, for each item listed, indicating the type of construction, finishes and method of installation related to adjoining construction.

.2 Manufacturer's printed literature may be considered sufficient to meet the above requirements, should they specifically indicate applicable details of the products and installation methods that apply to this project and are satisfactory to the Consultant.

1.5 Delivery, Storage & Handling

.1 Storage

.1 Materials and equipment to be properly stored so no deterioration by rusting of metals shall occur.

.2 Handling

.1 Damaged or deteriorated materials shall be removed from site.

1.6 Project Conditions

.1 Existing Conditions

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

2. PRODUCTS

2.1 Materials

.1 Steel (Sections & Plates): Conforming to CSA Standard G40.21-1992, Type 33W, unless otherwise noted.

.2 Welding Materials: to CSA Standard W59-1989.

.3 Galvanizing: Double hot dipped galvanizing with a minimum coating of 57 g of zinc per 300 mm² to CSA Standard G164-M92.

.1 Shop Coat Primer: to CGSB 1-GP-40M

.2 Galvanized Primer: Zinc rich, ready mix to CGSB 1-GP-181M.

2.2 Fabrication

.1 Members shall be fabricated to shape and size indicated with well defined sharp lines, angles and risers.

.2 Where possible, work to be fitted and shop assembled, ready for erection.

.3 Exposed surfaces shall be smoother with all fastenings and connection hidden where possible.

.4 Exposed welds to be continuous for length of joint except where specified otherwise.

.5 Shearing and punching shall leave clean, true lines and surfaces. Provide holes and connections for all other sections.

.6 Curved or brake formed work shall be evenly sprung.

.7 Joints exposed to the exterior shall be weather proof, with all joints in any members closely fitted and machined.

.8 Provide necessary rebates, lugs, brackets and supports so that all work can be assembled in a neat and substantial manner with ample strength and stiffness.

.9 Galvanizing shall be a hot-dip process.

.10 All exterior railings, handrails, guardrails, brackets and associated items of work shall be fabricated of galvanized materials.

.11 All components not galvanized shall be prime coated.

3. EXECUTION

3.1 Inspection

.1 Inspection of Structure

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

3.2 Preparation

.1 Field Measurement

.1 Where members are required to be installed neat between finished openings or walls, co-ordinate fabrication from drawing information supplemented with actual job site dimensions.

.2 Priming and Sealing

.1 Apply one shop coat of rust inhibitive primer to metal items, with exception of stainless steel, aluminum, and those to be galvanized or encased in concrete.

.2 Use primer unadulterated, as prepared by recognized manufacturer. Apply paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 45□F.

.3 Clean surfaces to be field welded; do not paint prior to welding. Paint over welded areas. (Use galvicon on welds on galvanized materials.)

3.3 Method of Work

.1 Erection

.1 Units which are required to be built in under other sections of work shall be supplied well in advance of the time required and accompanied by all necessary setting templates or placing drawings and diagrams.

.2 Wood plugs are strictly forbidden and shot set anchorage will not be permitted. Obtain prior approval on anchorage devices proposed to be used.

.3 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.4 Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts, or weld.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Provide seismic restraints on all piping, and equipment. Restraints shall be in accordance with the latest edition of the Seismic Restraint Manual for Mechanical Systems produced by SMACNA and the latest edition of the ASHRAE Applications Handbook Chapter 49 Seismic Restraint Design as well as current local building codes.

.2 Where rotating equipment is factory installed in a cabinet or enclosure and the vibration isolation mounts are also factory installed they shall have factory installed seismic restraints and provisions for anchoring complete unit to structure. The manufacturer shall supply certificates (signed by a Professional Engineer registered within the jurisdiction) verifying the design of the seismic restraints in accordance with the provisions of this section.

.3 Submit shop drawings of all seismic restraint details, prepared and sealed by a Professional Engineer registered in British Columbia.

.4 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the seismic restraints.

.5 Provide these letters of assurance sealed by a registered professional engineer for the seismic restraints, “Assurance of Professional design and commitment for field review” as well as “Assurance of Professional field review and compliance”.

2. PRODUCTS

.1 Provide slack cable restraint systems, or other acceptable systems (pipe snubbers, struts, etc.).

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

2.2 Approved Manufacturers

.1 Pipe Restraints

.1 Trelleborg.

3. EXECUTION

.1 Select the restraints for the specified seismic requirements. (These requirements are generally 0.8 g for normal fans and piping and 1.4 g for piping and equipment containing toxic materials).

.2 Select the anchor in the concrete slab for a load equal to one quarter of the weight of the fan at a 45° pull (0.35 x the specified seismic requirements).

.3 Install vibrating equipment on seismically rated isolators whenever possible.

.4 Where seismically rated isolators can not be used on vibrating equipment, use non-seismic isolators and provide slack cable restraints.

.5 For non-vibrating equipment, secure the equipment to the structure by:

.1 Bolting directly to the structure.

.2 Use rigid seismic restraints.

.3 Use taught cable restraints - not slack.

.4 Rigid restraints are preferable to cable restraints as cables have no compression load capabilities.

.6 Installation of bolts and fasteners:

.1 Torque bolts to 75% of proof load.

.2 For threaded connections use either self locking nuts, double nuts or a chemical thread lock (Loctite Series 242).

.7 Install cables using appropriate grommet, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connection points. Cables can be directly wrapped around the pipe as opposed to using collars.

.8 On piping systems, provide transverse slack cable restraints at a maximum spacing of *12.5 m* **(*40 ft.)*** and longitudinal restraints at *25* m **(*80 ft.)*** maximum spacing, or as limited by anchor/slack cable performance.

.9 Vary adjacent spacing of restraints on a piping by 10% to 30% to avoid coincident resonances.

.10 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within *600 mm* **(*24 in.)*** of the elbow or tee, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.

.11 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.

.12 At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed *10 m* **(*32 ft.)*** on centre with guide clearance not exceeding 3 mm. Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.

.13 Restraints shall be installed at least *25 mm* **(*1 in.)*** clear of all other equipment and services.

.14 Adjust restraint cables such that they are not visibly slack, or that the flexibility is approximately *35* mm **(*1.5 in.)*** under thumb pressure for a *1,500 mm* **(*5 ft.)*** cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable/spacer piece restraints to not exceed *6 mm* **(*1/4 in)***.

.15 Bolt all non-isolated equipment (eg. floor mounted tanks, heat exchangers, etc.) to the structure.

.16 300 mm Rule: As indicated in SMACNA, seismic restraint for piping and ductwork is not required if suspended less than 300 mm from supporting structure. This rule does not apply to equipment. Where beams occur, the pipe/duct must be supported from the beams for the rule to apply.

3.2 Piping

.1 Provide restraint details on piping and equipment as follows.

.2 Vertical Piping

.1 Attachment - Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and, if over 2 stores in height, at each floor by approved metal floor clamps.

.2 Screwed pipe - Screwed pipe (I.P.S.) shall be supported at not less than every other storey height.

.3 Copper tubing - Copper tubing shall be supported at each storey for piping 40 mm and larger diameter, and at not more than 1.8 m intervals for piping 40 mm and smaller in diameter.

.4 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.

.3 Horizontal Piping

.1 Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.2 Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 3 m intervals.

.3 Copper tubing - Copper tubing shall be supported at approximately 1.8 m intervals for tubing 40 mm and smaller in diameter and 3 m intervals for tubing

.4 50 mm and larger id diameter.

.5 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.

.4 Provide transverse bracings at 12.2 m o.c. maximum unless otherwise noted.

.5 Provide longitudinal bracings at 24.4 m o.c. maximum unless otherwise noted. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.

.6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 600 mm of the elbow or tee of similar size.

.7 For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using "Seismic Drift" in place of "Expansion Per Joint Manufacturers" selection table. Seismic Drift = 0.015 ft. per foot of height 12 mm/m of height.

.8 Do not use branch lines to brace main lines.

.9 Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connected to equipment with vibration isolators.

.10 A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.11 Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

.12 At vertical pipe risers, wherever possible, support the weight of the riser at a point of points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.

.13 Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 300 mm or more from supporting structure shall be braced on each side of a change in direction of 90° or more. Riser joints shall be braced or stabilized between floors.

.14 For gas piping, the bracing details, schedules and notes may be used except that transverse bracing shall be at 6.1 m o.c. maximum and longitudinal bracing at 12.2 m o.c. maximum. 25, 30, 40 & 50 mm diameter pipes shall be braced the same as 65 mm diameter pipe in the schedule. (No bracing is required for pipes 18 mm diameter and smaller.)

.15 The seismic bracing and support of fire sprinkler piping is not part of this specification.

.16 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings.

3.3 Non-Isolated Floor Mounted Equipment

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

3.4 Isolated Piping And Equipment

.1 Install cables using appropriate grommets, shackles and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.

.2 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.

.3 Install restraints at least 50 mm clear of all other equipment and services.

.4 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm under thumb pressure for a 1.5 m cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm.

.5 Provide transverse and axial restraints as close as practical to a vertical bend.

.6 At steel trusses, connect to top chords and follow truss manufacturer's instructions.

.7 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.

.8 Orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45° to the slab.

.9 Select the anchors in the concrete slab for a load equal to twice the weight of the equipment.

END OF SECTION

1. GENERAL

1.1 Scope

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

1.2 Qualifications

.1 All vibration isolators and bases shall be supplied by an acceptable supplier with the exception of isolators which are factory installed and are standard equipment with the machinery.

.2 Provide shop and placement drawings for all vibration isolation elements for review, before materials are ordered. The drawings shall bear the stamp and signature of the responsible supplier's technical representative.

.3 The work shall be carried out in accordance with the specification and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.

.4 Seismicary rated isolators shall be made part of the seismic restraint systems scope of work and become the responsibility of the contractor’s seismic engineer/supplier.

1.3 Samples

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

1.4 Submittals

.1 Provide vibration isolation shop drawings showing isolator locations, load on each isolator, inertia slab dimensions.

.2 Provide details and calculations for attachment of isolator to equipment and structure. Drawings to show calculated tension and shear forces at anchor/structure interface and device/equipment interface. Drawings must confirm that the isolator restraint component or independent restraint device meets or exceeds the project seismic requirements.

1.5 General Requirements

.1 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.

.2 Provide vibration isolation on all motor driven equipment with motors of 0.37 kW and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 0.37 kW, provide neoprene grommets at the support points.

.3 Provide seismic restraint for all isolated equipment. Isolators for all base mounted equipment shall incorporate seismic restraints or be used in conjunction with an independently rated seismic restraint system..

.4 Electrical cable connected to isolated equipment shall allow for a minimum +/-25 mm of equipment movement in any direction.

.5 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness in selection of elastomers and do not exceed 60 durometer.

.6 Provide spring thrust restraints on all fans (except vertical discharge) in excess of 1 kPa static pressure, and on hanger supported, horizontally mounted axial fans with more than 333 N thrust due to static pressure.

.7 Isolators and restraining devices which are factory supplied with equipment shall meet the requirements of this section.

.8 Provide concrete inertia bases where specified or required by equipment manufacturers located between all vibrating equipment and the vibration isolation elements. Provide inertia bases on centrifugal fans with static pressure in excess of 875 Pa and/or motor in excess of 30 kW, except slab on grade installations. Refer to structural specifications for concrete work. Concrete work by General Contractor.

.9 Co-ordinate with Division 3 for the provision of housekeeping pads at least 100 mm high under all isolated equipment. Provide at least 175 mm clearance between drilled inserts and edge of housekeeping pads and follow structural consultant's instructions for drilled inserts.

.10 Bolt all equipment to the structure. Do not bridge isolation elements.

.11 For isolated equipment, design anchors, bolts, isolators and bases to withstand without failure or yielding the seismic forces as defined by the BC and/or National Building Code. Should individual pieces of seismic hardware be incapable of withstanding the calculated forces, provide additional restraint to ensure that the system, as a whole, meets these requirements.

1.6 Regulatory Requirements

.1 Tested values must show that the seismic restraint hardware used in conjunction with the vibration isolation product is capable of withstanding the increased forces, as calculated for the specific project, using the formulae provided in the BC and/or National building codes.

.2 Reference BC building code sections 4.1.9.1(15) and 6.2.1.9(2) regarding seismic requirements of integral isolation/restraint devices.

.3 Post Disaster projects not only require that the seismic restraint of the resiliently mounted systems be design to withstand a seismic event but also that the equipment be functional following a design earthquake, provided that the building structure has not been compromised. Isolation/restraint supplier shall submit a dynamic analysis on each piece of equipment which has been specified as requiring post disaster restraint, indicating expected movements at all flexible connections to the structure. Contractor will coordinate with other divisions to ensure that these expected movements can be accommodated. Equipment manufacturers must confirm that the amplified forces to their equipment do not exceed the equipment or its component’s fragility levels.

1.7 Inspection

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

2. PRODUCTS

2.1 Approved Manufacturers

.1 Vibration Isolation: Mason, Vibro Acoustic.

.2 Flexible Connectors – Ducting: Thermaflex, G.I. Industries Type IHP.

.3 Flexible Connectors – Piping: Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible.

2.2 Isolators

.1 Spring isolators located out of doors or in humid areas shall have Rustoleum painted housing and neoprene coated springs, unless otherwise indicated on drawings.

.2 Isolation mounts for equipment with operating weights substantially different from the installed weights, such as chillers or boilers, shall have adjustable limit stops.

2.3 Open Spring Isolators

.1 Springs shall be "Iso-Stiff" having equal stiffness in the horizontal and vertical planes with a working deflection between 0.3 and 0.6 of solid deflection.

.2 Spring mounts shall be complete with levelling devices, minimum *6 mm* ***(1/4 in.)*** thick neoprene sound pads and zinc chromate plated hardware.

.3 Sound pads shall be sized for a minimum deflection of *1.2 mm* ***(1/16 in.)*** and shall meet the requirements for neoprene isolators.

2.4 Closed Spring Isolators

.1 Compression springs shall be used both for hangers and floor mount isolators.

.2 Springs shall be stable under operating conditions.

.3 Housings shall incorporate a minimum *6 mm* ***(1/4 in.)*** thick sound pad sized for a minimum static deflection of *1.2 mm* ***(1/16 in.)*** meeting the requirements for neoprene isolators.

.4 Floor mount units shall incorporate neoprene side stabilizers with a minimum 6 mm clearance.

2.5 Neoprene Isolators

.1 All neoprene isolators shall be tested to latest ASTM specifications.

.2 Where a ribbed pad is used, the height of the ribs shall not exceed 0.7 times the width of the rib. A steel layer shall be used to distribute the load in a multi-layered unit.

.3 Neoprene pads or elements shall be selected at the manufacturer's optimum recommended loading and shall not be loaded beyond the limit specified in the neoprene manufacturer's literature.

2.6 Inertia Bases

.1 Concrete inertia bases shall be a minimum of 1.5 times the weight of the isolation equipment and shall be constructed using a channel iron perimeter and adequate reinforcing. The concrete shall be rated at *20 MPa* ***(3000 psi)***. Design shall be by the isolation suppliers.

.2 Concrete inertia bases shall meet the requirements of the isolation supplier's shop drawings.

.3 Structural steel bases shall be sufficiently rigid to prevent misalignment or undue stress on the machine, and to transmit design loads to the isolators.

2.7 Spring Hangers

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

3. EXECUTION

3.1 Application

.1 Provide vibration isolator for mechanical motor driven equipment throughout, unless specifically noted otherwise.

.2 Set steel bases for *25 mm* ***(1 in.)*** clearance between housekeeping pad and base. Set concrete inertia bases for *50 mm* ***(2 in.)*** clearance. Adjust equipment level.

.3 Deflections *12 mm* ***(1/2 in.)*** and over shall use steel spring isolators.

.4 Deflections *5 mm* ***(0.2 in.)*** and under shall use neoprene isolators.

.5 All equipment mounted on vibration isolators shall have a minimum clearance of *50 mm* ***(2 in.)*** to other structures, piping equipment, etc. All isolators shall be adjusted to make equipment level.

.6 Prior to making piping connections to equipment with operating weights substantially different from installed weights, the equipment shall be blocked up with temporary shims to the final heights. When full load is applied, the isolators shall be adjusted to take up the load just enough to allow shim removal.

.7 Adjustable, horizontal stabilizers on close spring isolators shall be adjusted so that the side stabilizers are clear under normal operating conditions.

.8 All piping connections to isolated equipment shall be supported resiliently for the following distances or to the nearest flexible pipe connector.

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

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

.9 Spring hangers shall be installed without binding.

.10 Adjust isolators as required and ensure springs are not compressed.

.11 Provide neoprene side snubbers or retaining springs where side torque or thrust is developed.

.12 Where movement limiting restraints are provided, they shall be set in a position with minimum *6 mm* ***(1/4 in.)*** air gap. Restraints, isolator equipment and attachment points shall be designed to withstand the impact of the isolated equipment subjected to an acceleration not exceeding 3 g without permanent distortion or damage.

.13 Wiring connections to isolated equipment shall be flexible.

3.2 Performance

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

.2 Install isolators of type and deflection as indicated on the Isolation Schedule or according to the following table, whichever provides the greater deflection.

The required static deflection of isolators for equipment exceeding *0.35 kW* ***(1/2 Hp)*** is indicated below. Spring isolators shall be "open spring". Closed spring isolators shall only be used where specified.

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

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

END OF SECTION

1. GENERAL

1.1 General Requirements

.1 Access for maintenance or adjustment of all parts of the mechanical system shall be provided. This shall apply but not be limited to valves, volume dampers including splitter dampers, fire dampers, cleanouts and controls.

.2 Where equipment is concealed by a removable tile ceiling, the location of equipment shall be indicated by coloured markings on the T bar system.

.3 Where equipment is concealed by a continuous structural or architectural surface, supply access doors of design to suit and match the surface in which they will be installed.

.4 Provide stainless steel doors in walls of washrooms, kitchen, janitor rooms and laundry rooms.

.5 All fasteners on access panels shall be tamper proof, contractor shall provide three (3) sets of keys.

1.2 Submittals

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

2. PRODUCTS

2.1 Approved Manufacturers

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

2.2 Drywall Surface:

.1 Valve and Damper Access:

.1 Acudor DW-5040 with flange of textured galvanized steel drywall taping bead with prepunched holes. Installed after drywall.

.2 Concealed Equipment Access:

.1 Baucoplus series fabricated with extruded aluminum frame with gypsum board inlay and structural corner elements. Hinge to be concealed 2-point hinge, non corroding with screw driver cam latch.

2.3 Masonry Wall

.1 Acudor UF-5000 universal flush door.

2.4 Tile Surface

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

2.5 Fire Rated Walls

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

2.6 Fire Rated Ceilings

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

2.7 Ductwork

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

3. EXECUTION

3.1 Installation

.1 Access doors are to be provided by the Mechanical Division. Installation in building construction to be by the ceiling contractor. Access doors in mechanical equipment to be provided and installed by the mechanical division.

.2 Door Sizes:

.1 300 mm x 300 mm minimum for inspection and hand access.

.2 450 mm x 450 mm minimum, larger if indicated on drawings, where entry is required and access is difficult.

.3 Flush to frame type steel door with rounded safety corners: 16 GA door, 18 GA frame for inspection and hand access types. Concealed bar hinge and one piece trim flange.

.4 Concealed equipment access door frames shall have edges similar to drywall bead against which ceiling surfaces can be finished.

.5 For ductwork provide access doors with lever locks, insulated for insulated ductwork.

.6 Cam type, screwdriver operated locking device on the side opposite the hinges.

.7 Prime coat grey baked enamel after 5 stage iron phosphate preparation, or stainless steel #4 satin finish where required.

.8 Size to suit masonry modules when located in a masonry wall.

.9 When located in a finished floor with tile, stonework, terrazzo, etc., a recessed bearing type access door is required. The door surface shall have a recess to take the particular surface material and pattern if this is available at the time the units are ordered.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Provide meters, gauges, and taps where shown on drawings and/or specified herein.

.2 Submit shop drawings of proposed products to the Consultant for review.

.3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges to the Engineer for review.

2. PRODUCTS

2.1 Approved Manufacturers

.1 Gauges – Air: Dwyer, Magnehelic.

.2 Gauges – OWG Pressure: Trerice, Marsh, Ashcroft, Weiss.

.3 Thermometers: Trerice, Marsh, Ashcroft, Winteres.

2.2 Thermometers

.1 Dial Thermometers: 75 mm (3 in.) diameter dial in drawn steel case, bimetallic helix actuated, brass separable socket of flange and bushing, glass cover, adjustable pointer.

.2 Mercury Thermometer: Red reading mercury filled, 2° graduations, aluminum case, 230 mm (9 in.) scale, straight shank, separable socket, and adjustable angle.

2.3 Thermometer Well

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

2.4 Pressure Gauges

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

2.5 Pressure Gauge Taps

.1 Brass needle valve.

3. EXECUTION

3.1 Installation

.1 Provide one pressure gauge per pump installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

.2 Select gauges so that normal operating point is approximately mid-point of instrument range.

.3 On pipes 65 mm (1½ in.) and smaller, place well in tee used in lieu of an elbow to accommodate well.

3.2 Meters and Gauges Installation Schedule

.1 Pressure Gauges:

- .1 Pumps
- .2 Expansion tanks
- .3 Pressure tanks
- .4 Leaving side of automatic make-up valves
- .5 Where shown on drawings

.2 Pressure Gauge Taps:

- .1 Both sides of two-way control valves
- .2 All lines to three-way control valves
- .3 Major coils, inlet and outlet
- .4 Heat exchangers, inlet and outlet, tube and shell side
- .5 Chillers, inlet and outlet
- .6 Where shown on drawings

.3 Thermometers:

- .1 Supply and return headers of central equipment
- .2 Boilers, inlet and outlet
- .3 Heating water zone supply and return mains
- .4 Heating and cooling coils, inlet and outlet
- .5 Where shown on drawings

.4 Thermometer Wells Only:

- .1 All lines to three-way control valves
- .2 Where shown on drawings

END OF SECTION

1. GENERAL

1.1 Scope

.1 Pipe hangers and supports.

.2 Duct hangers and supports.

.3 Flashing for mechanical equipment.

.4 Sleeving for mechanical equipment.

.5 Pipe anchors.

1.2 Reference Standards

.1 Pipe supports shall meet the requirements of current edition of ANSI B31.1, Power piping.

.2 Automatic sprinkler pipe supports shall meet the requirements of current edition of NFPA No. 13, Standard for the Installation of Sprinkler Systems.

.3 Standpipe and hose system pipe supports shall meet the requirements of current edition of NFPA No. 14, Standard for the Installation of Standpipe and Hose Systems.

.4 Duct hangers shall follow the recommendations of the current edition of the SMACNA Duct Manuals.

1.3 Submittals

.1 Submit shop drawings of each factory manufactured component.

1.4 General Requirements

.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, and provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.

.2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

.4 Fasten hangers and supports to building steel or inserts in concrete construction.

.5 Provide and set sleeves required for equipment, including openings required for placing equipment. Provide sleeves for all pipe and duct penetrations through walls, ceilings, floors and footings.

.6 Dielectrically isolate dissimilar metals.

.7 Obtain approval from the Consultant prior to drilling for inserts and supports for piping systems.

.8 Obtain approval from the Consultant prior to using percussion type fastenings.

.9 Use of piping or equipment for hanger supports is not permitted.

.10 Use of perforated band iron, wire or chain as hangers is not permitted.

.11 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Consultant and Structural Consultant.

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

2. PRODUCTS

2.1 Inserts

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

.2 Size inserts to suit threaded hanger rods.

2.2 Pipe Hangers and Supports

.1 Hangers: Pipe sizes *15 mm* ***(½ in.)*** to *40 mm* ***(1½ in.)***: Adjustable wrought steel ring.

.2 Hangers: Pipe sizes *50 mm* ***(2 in.).*** to *100 mm* ***(4 in.)*** and Cold Pipe Sizes *150 mm* ***(6 in.)*** Over: Adjustable wrought steel clevis.

.3 Hangers: Hot Pipe Sizes *150 mm* ***(6 in.)*** and over: Adjustable steel yoke and cast iron roll.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes *150 mm* ***(6 in.)*** and over.

.5 Wall Support: Pipe Sizes to *80 mm* ***(3 in.)***: Cast iron hook.

.6 Wall Support: Pipe Sizes *100 mm* ***(4 in.)*** and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes *150 mm* ***(6 in.)*** and over.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Pipe Sizes to *100 mm* ***(4 in.)*** and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.

.9 Floor Support: Hot Pipe Sizes *125 mm* ***(5 in.)*** and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.

.10 Install hangers so they cannot become disengaged by movements of supported pipe.

.11 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping. Provide galvanized hangers and supports for galvanized piping.

.12 Support all piping below grade and under floor slabs in *3.2 mm* ***(1/8 in.)*** continuous cadmium plated channel. Support channel with cadmium plated clevis hangers and rods. Install supports on centres as specified in 3.2. Extend cadmium plated hanger rods *450 mm* ***(18 in.)*** above slab rebar and bend back over rebar so as to provide a minimum of *450 mm* ***(18 in.)*** of support in slab. Do not stress rod when bending.

2.3 Hanger Rods

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

2.4 Flashing

.1 Steel Flashing: *0.55 mm* ***(26 ga.)*** galvanized steel.

.2 Lead Flashing: *25 kg/m²* ***(5 lb/ft²)*** sheet lead for waterproofing, *5 kg/m²* ***(1 lb/ft²)*** sheet lead for soundproofing.

.3 Safes: *25 kg/m²* ***(5 lb/ft²)*** sheet lead or *0.5 mm* ***(0.02 in.)*** neoprene.

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

2.5 Sleeves

.1 Pipes through Floors: Form with *1.2 mm* ***(18 ga.)*** galvanized steel.

.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or *1.2 mm* ***(18 ga.)*** thickness galvanized steel.

.3 Ducts: Form sleeves with galvanized steel.

.4 Size large enough to allow for expansion with continuous insulation.

2.6 Pipe Seals

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

2.7 Finishes on Hanger Rods, Hangers and Supports

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

3. EXECUTION

3.1 Inserts

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over *100 mm* ***(4 in.)*** or ducts over *1500 mm* ***(60 in.)*** wide.

.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.2 Pipe Hangers and Supports

.1 Support horizontal steel and copper piping as follows:

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

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

.3 Place a hanger within *300 mm* ***(12 in.)*** of each horizontal elbow.

.4 Use hangers which are vertically adjustable *40 mm* ***(1½ in.)*** minimum after piping is erected.

.5 Support horizontal soil pipe near each hub with *1.5 m* ***(5 ft.)*** maximum spacing between hangers.

.6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Where practical, support riser piping independently of connected horizontal piping.

.9 Use oversized hangers to accommodate pipe insulation thickness. For pipes up to *50 mm* ***(2 in.)*** use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes *65 mm* ***(2½ in.)*** and over, use insulation protection saddle.

3.3 Equipment Bases and Supports

.1 Provide for floor mounted equipment, reinforced concrete housekeeping bases poured directly on structural floor slab *100 mm* ***(4 in.)*** thick minimum, extended *100 mm* ***(4 in.)*** minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.

.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.3 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

3.4 Flashing

.1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

.2 Flash vent and soil pipes projecting *75 mm* ***(3 in.)*** minimum above roof membrane with lead worked *25 mm* ***(1 in.)*** minimum into hub, *200 mm* ***(8 in.)*** minimum clear on sides with minimum *600 x 600 mm* ***(24 x 24 in.)*** sheet size. For pipes through outside walls turn flange back into wall and caulk.

.3 Flash floor drains over finished areas with lead *250 mm* ***(10 in.)*** clear on sides with minimum *920 x 920 mm* ***(36 x 36 in.)*** sheet size. Fasten flashing to drain clamp device.

.4 Provide curbs for mechanical roof installations minimum *200 mm* ***(8 in.)*** high. Flash and counterflash with steel; solder and make waterproof.

.5 Provide continuous lead or neoprene safes below air supply casings, built-up mop sinks, shower stalls, shower room floors located above finished rooms. Solder at joints, flash into floor drains and turn up *150 mm* ***(6 in.)*** into walls or to top of curbs and caulk into joints.

.6 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

3.5 Sleeves

.1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeve.

.2 Extend sleeves through potentially wet floors *25 mm* ***(1 in.)*** above finished floor level. Caulk sleeves full depth and provide floor plate.

.3 Piping and duct work passing through floor, ceiling or wall, close off space between duct and sleeve and non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

.4 Piping passing through mechanical room floor, roof or wall, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.

.5 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a *25 mm* ***(1 in.)*** "flange" welded to the external face of the sleeve at the mid point of the thickness of the structure to provide a water stop.

.6 Install chrome plated escutcheons where piping passes through finished surfaces.

END OF SECTION

1. GENERAL

1.1 Related Work in Other Sections

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

1.2 Qualifications

.1 Installation work by competent qualified tradesmen only.

2. PRODUCTS

2.1 Materials

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

3. EXECUTION

3.1 Installation

.1 Counterflashings are attached to mechanical equipment and lap the base flashings on the roof curbs.

.2 All joints in counterflashings shall be flattened and solder double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.

.3 Vertical flange section of roof jacks shall be screwed to face of curb.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Provide for cleaning and degreasing of hot water heating, and any other hydronic system affected by this project scope of work.

.2 Provide all necessary equipment and chemicals to treat hot water heating, and any other system affected by this project scope of work.

.3 Provide for flushing and disinfection of domestic water systems.

1.2 Acceptable Agency

.1 Chemical treatment agency shall provide equipment, chemicals and site supervision so as to fully comply with all requirements and their intent contained within this specification section.

.2 Acceptable Agency: Dearborn, Pace, IPAC Chemicals Ltd.

1.3 Quality Assurance

.1 Perform the cleaning and degreasing operation on site in conjunction with the mechanical contractor and submit written reports on all situations found, actions taken and final results. Reports shall be signed by the (contractor), (commissioning coordinator), and chemical treatment agency. Inform the Consultant and commissioning agency fifteen (15) working days prior to commencing of work.

.2 Provide chemical treatment as specified herein and provide written reports. Reports shall be signed by the chemical treatment agency, mechanical contractor and commissioning agency.

.3 Chemical treatment agency shall provide directive and assistance to the mechanical contractor in the degreasing, cleaning and chemical treatment of all piping systems. Use of the permanent mechanical systems for pumping or heating of cleaning and dilution solutions is not permitted. Permanent systems shall be isolated and portable pumps and boilers utilized for the duration of the cleaning process. Permanent equipment shall be flushed, degreased and chemically treated independent of the piping systems.

1.4 Submittals

.1 Submit shop drawings with complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment to be supplied. Along with product shop drawings, provide copies of data sheets, procedure instructions and analysis reports to be used on this project. Shop drawings shall be submitted within 10 working days of the award of contract.

.2 Include with the shop drawings Material Safety Data Sheets (MSDS) for all chemicals to be used.

.3 Provide written reports containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.

.4 Submit written reports to the mechanical contractor and Consultant containing results of tests taken every seven days after completion of chemical treatment. Reports shall be done every seven days for a minimum time period of 35 days.

.5 Provide monthly site visits (12 minimum) within the warranty year to check the treatment, take samples, analyze and recommend proper addition of treatment. Provide written reports to the owner after each visit with a copy to the Consultant.

2. PRODUCTS

2.1 Materials

.1 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the owner.

.2 Materials which may contact finished areas shall be colorless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.

.3 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.

.4 Close System Treatment: Sequestering agent to reduce deposits and adjust pH, and a corrosion inhibitor.

2.2 Equipment

.1 Solution Pumps: All closed hot water and chilled water systems shall have positive displacement diaphragm type metering pumps for adding chemicals. Pumps shall have an adjustable flow rate and be suitable for chemicals to be pumped. Pumps shall be self flushing. Pumps provided with plastic solution tanks complete with agitator, pump mounting, cover, provision for fill line and pump strainer. Size the pumps and tanks to permit operation for three days at 50% pump capacity without refill of tanks. Agitator motor provided with terminals and junction box for electric wiring.

.2 Chemical pot feeder: All closed hot water and chilled water systems shall have one pot feeder per system.

.3 Sidestream Filter: All closed hot water and chilled water systems shall have a sidestream filter housing of steel construction using a 250 mm x 30 micron filter cartridge, with a minimum flow rate of 35 litres per minute. A Flow Indicator with stainless steel impeller shall be installed in conjunction with the sidestream filter. Connections shall be 18 mm NPT and all isolating valves shall be installed as per manufacturer's instructions. Include 10 filter cartridges.

.4 Chemical Feed Piping: Shall be Schedule 40 black steel.

2.3 Test Kits

.1 Provide test kits as required to determine proper system treatment consisting of, but not limited to the following:

.1 Heating water test kit to determine proper treatment.

.2 Provide test kits for hardness and chlorides in addition to those listed above.

.3 Provide an electronic pH meter complete with three different calibration standard solutions.

.4 All test kits shall be provided with adequate chemicals and reagents for one year of testing.

3. EXECUTION

3.1 System Cleaning

.1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe during construction. This is to include proper protection of piping on site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.

.2 Chemical treatment agency shall, in conjunction with the mechanical contractor, review connections for complete draining and venting of the systems. The mechanical contractor shall provide adequate drain connections to completely drain the systems within one hour. Utilize water meter to record capacity within each system, and record for maintenance manuals.

.3 Protect and/or remove control devices from systems during cleaning. All terminal control valves shall be in open position during cleaning. Particular attention is to be made to control valves which have a normally closed position.

.4 Make systems completely operational, totally filled, thoroughly vented, and completely started.

.5 Add system cleaner and degreasant to flow systems at concentration of 1 kg per 1000 L8.3 lb per 1000 USgal of water contained in systems for hot systems.

.6 For hot water heating systems apply heat while circulating, raise temperature to 71°C160°F slowly and maintain at 71°C160°F for a minimum of 12 hours. Remove heat and circulate systems to 38°C100°F or less. Drain system, entirely at one time, including all low points and coils. Intermittent start/stop of drainage is not approved. The mechanical contractor to provide additional temporary pipe, pumps as necessary and drainage location for complete drainage. Refill the entire system with clean water, circulate for six hours at design temperature, provide complete venting and deaeration, repeat the draining procedure. Refill complete system with clean water and retest.

.7 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils, boilers, etc. shall be done prior to final fill and chemical treatment.

.8 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre190 mg per USgal and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 mg per L75 mg per USgal. If less than 20 mg per L75 mg per USgal repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav., sinks, flushometers, etc.) for drainage.

3.2 Heating Water Systems

.1 Each individual system shall have one pot feeder. Complete with isolating and drain valves and necessary piping. Contractor shall provide new as required.

.2 Treat closed systems with closed systems treatment introduced through pot feeder when required or indicated by test.

END OF SECTION

1. GENERAL

1.1 Quality Assurance

.1 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31.1, ANSI B16.25, ASME Section IX, and the Provincial Board of Labour Regulations latest current editions.

.2 Use welders fully qualified and licensed by Provincial Authorities.

2. PRODUCTS

2.1 Approved Manufacturers

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

2.2 Pipe

	Service	Material
.1	Hot water and glycol heating to *120°C **250°F***	Steel, Sch.40, ASTM A53, Grade B heating to *120°C **250°F***
.2	Equipment drains and overflows	Sch.40, galvanized steel, ASTM A120

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

2.3 Fittings and Joints

	Service	Material	Joint
.1	Hot water and glycol heating *120°C**250°F***	Banded malleable iron, *1033 kPa**150 psi***, up to *50 mm**2 in.***	Screwed,
		Steel, same schedule as pipe, for sizes *50 mm**2 in.*** and larger	Welded
		Wrought copper,	95-5 solder, brazed bronze, for pipes over *50 mm**2 in.***
		Cast brass	Screwed
		Cast bronze	Flare tube
.2	Equipment drains and overflows	Galvanized banded malleable iron	Screwed
		Wrought copper, bronze	50-50 solder
		Cast brass	Screwed

2.4 Unions, Flanges and Couplings

.1 *Size 50 mm**2 in.*** and under: *1033 kPa**150 psi*** malleable iron, bronze to iron ground joint unions for threaded ferrous piping, air tested for gas service, all bronze for copper piping.

.2 Sizes *65 mm**2½ in.*** and over: *1033 kPa**150 psi*** forged steel welding neck flanges for ferrous piping, *1033 kPa**150 psi*** bronze slip-on flanges for copper piping. Gaskets shall be *1.5 mm**1/16 in.*** thick performed synthetic rubber bonded asbestos.

.3 Flange bolting: For systems up to *120°C**250°F***, use carbon steel stud bolts, semi-flushed and heavy hex nuts, ASTM A307-GrB. For systems up to *215°C**420°F***, use alloy steel bolts ASTM A193-GrB7, and semi-finished heavy hex nuts ASTM A194-Gr2H.

.4 Where permitted by the Consultant, use grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Couplings consist of malleable iron housing-clamps, C-shaped composition sealing gasket EPDM Grade `E' and steel bolts. Use galvanized couplings for galvanized pipe. Victaulic brand or Grinnel Gruv-Lok only

2.5 Grooved Mechanical Piping

.1 Grooved Mechanical is acceptable on chilled water, condenser water, potable water, compressed air lines, fire protection, equipment drains and overflows.

.2 Couplings: Contractor shall use “Zero Flex” Rigid Couplings in all applications except where flexible style couplings are approved by the Engineer for use at equipment connections. An installation diagram will need to be approved by Engineer prior to installation.

.3 For copper connections 2” to 4”, Contractor shall use Victaulic Style 606 Couplings complete with EPDM Flush Seal Gasket. Coupling has angle bolt pad to provide a rigid joint.

.4 When transitioning between grooved ductile iron and grooved copper in a potable water system, Contractor shall use the Groove X Groove Style 47 Dielectric Water Way.

.5 Butterfly Valves: Where Victaulic piping system is used, Contractor shall incorporate Victaulic Style 300 Butterfly, complete with EPDM Grade “E” encapsulated disc, rated to 300 PSI dead en service. In compressed air lines, Contractor shall incorporate Style 300 complete with Nitrile Grade “T” encapsulated disc.

.6 For Victaulic grooved joints, pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket seating. The gasket style and elastomer material (grade) shall be verified as suitable for the intended service as specified.

.7 Contractor shall verify the pipe and grooves meet Victaulic’s current specifications. Acceptable products - Victaulic brand or Grinnel Gruv-Lok.

3. EXECUTION

3.1 Preparation

.1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

.2 Protect all steel pipes when stored on site from external conditions and ensure protective coating remains intact. If in the opinion of the Consultant, deterioration of the protective coating has instigated corrosion, all rust must be removed down to bare metal and prime coated with red oxide paint.

3.2 Connection

.1 Screw joint steel piping up to and including *40 mm**1½ in***. Weld piping *65 mm**2½ in.*** and larger, including branch connections. Screw or weld *50 mm**2 in.*** piping for liquid systems, weld *50 mm**2 in.*** piping for air and gas systems.

.2 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.

.3 Make joints for plain end pipe with gasket and clamp type mechanical fastener.

.4 Clamp cast iron water pipe at fittings with *20 mm¾ **in.*** rods and properly anchor and support.

.5 Use grooved mechanical couplings and mechanical fasteners, only where permitted by the Consultant.

.6 Use galvanized couplings with galvanized pipe.

.7 Make connections to equipment, specialty components, and branch mains with unions or flanges.

.8 Provide dielectric type connections wherever joining dissimilar metals in open systems. Brass adapters and valves are acceptable.

.9 Use insulating plastic spacers for copper pipe installation in metal studs.

3.3 Route and Grades

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

.2 Slope water piping 0.2% and provide hose bibb drains at low points.

.3 Equip low points with *20 mm¾ **in.*** drain valves and hose nipples.

.4 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be *25 mm**1 in.*** dia. or line size whichever is greater and *150 mm**6 in.*** high minimum. Square tees may only be used to assist with complete venting and draining.

.5 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blowdowns, water columns and overflows to the nearest building drain.

3.4 Installation

.1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

.3 Install piping material specified as inside the building to *2500 mm**8 ft.*** outside of building.

.4 Yellow jacket buried steel lines, joints and fittings, prime coat and paint lines exposed to outdoors.

3.5 Welded Pipe Branch Connections

.1 Make branch connections according to the following schedule.

Legend:

T: Forges tee or reducing tee

S: Socolet

W: Weldolet

	*15**½ in.***	T												
	*20**¾ in.***	T	T											
	*25**1 in.***	T	T	T										
	*30**1¼ in.***	T	T	T	T									
	*40**1½ in.***	T	T	T	T	T								
	*50**2 in.***	S	S	S	T	T	T							
HEADER	*65**2½ in.***	S	S	S	S	T	T	T						
	*75**3 in.***	S	S	S	S	S	T	T	T					
	*100**4 in.***	S	S	S	S	S	T	T	T	T				
	*150**6 in.***	S	S	S	S	S	W	T	T	T	T			
	*200**8 in.***	S	S	S	S	S	W	W	W	T	T	T		
	*250**10 in.***	S	S	S	S	S	W	W	W	W	T	T	T	
	*300**12 in.***	S	S	S	S	S	W	W	W	W	W	T	T	T
		15	*20*	*25*	*30*	*40*	*50*	*65*	*75*	*100*	*150*	*200*	*250*	*300*
		½”	***¾”***	***1”***	***1¼”***	***1½”***	***2”***	***2½”***	***3”***	***4”***	***6”***	***8”***	***10”***	***12”***

BRANCH

END OF SECTION

1. GENERAL

1.1 Scope

.1 Gate valves.

.2 Globe or angle valves.

.3 Ball valves.

.4 Check valves.

.5 Plug cocks.

.6 Eccentric plug valves.

.7 Butterfly valves.

.8 Drain valves.

.9 Hose bibbs.

.10 Strainers.

1.2 Manufacturer

.1 Provide valves of the same type by the same manufacturer throughout.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

1.3 Shop Drawings

.1 Submit copies of valves "ordering schedule" for review before ordering valves.

.2 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

2. PRODUCTS

2.1 Approved Manufacturers

.1 Valves – Butterfly: Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinell.

.2 Valves – Circuit Balancing: Armstrong, B & G, Wheatly, Tour & Anderson.

.3 Valves – Drain, Radiator: Jenkins, Dahl, Crane, Toyo, Kitz.

.4 Valves – Eccentric Plug: DeZurik, Homestead.

.5 Valves – Gate, Globe, Swing, Check, Ball: Jenkins, Toyo, Crane, Kitz, Milwaukee.

.6 Valves – Plumbing Flush: Crane, Sloan, Teck.

.7 Valves – Pressure Balanced Mixing: Symmons.

.8 Valves – Pressure Reducing: Armstrong, Bell & Gossett, Taco.

.9 Valves – Relief: Armstrong, Bell & Gossett, Taco, Wheatley.

.10 Valves – Shower: Symmons, Powers.

.11 Valves – Silent Check: Val-matic, APCO, StreamFlo.

.12 Valves – Suction Diffusers Combination Check and Balance: Armstrong, B&G, Taco.

.13 Valves – Thermostatic Mixing: Symmons, Poweres.

.14 Valves – Water Pressure Reducing: Watts, Clayton, Singer, Zurn, Wilkins, BCA, Cash Acme, Braukman.

.15 Plug Cocks: DeZurik, Newman-Milliken.

2.2 Domestic Cold Water System

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

.2 Globe Valves up to 50 mm 2 in.: Bronze body, screw over bonnet, threaded ends rating 1035 kPa 150 psi steam, solder ends rating 2070 kPa 300 psi water. Threaded, Red-White Fig. 221. Solder ends, Red-white Fig. 222.

.3 Globe Valves 65 mm 2½ in. and over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disc. Rating 860 kPa 125 psi steam. 1380 kPa 200 psi. Red-White Fig. 400.

.4 Butterfly Valves: Cast iron wafer full-lug body, 300 Series stainless steel shaft, bronze disc, replaceable EPDM seat, lever lock handle operator with multiple position lock plate for valve sizes to 100 mm 4 in., heavy duty gear handwheel operator with position indicator for valve sizes 150 mm 6 in. and over. Minimum rating 1200 kPa 175 psi, 121°C 250°F. Keystone F1000, F1020.

.5 Gate Valves up to 50 mm 2 in.: Bronze body, inside screw, travelling stem, solid wedge, screw-in bonnet, threaded ends rating 860 kPa 125 psi steam, solder ends rating 1380 kPa 200 psi water. Threaded, Red-White Fig. 293. Solder ends, Red-White Fig. 299.

.6 Gate Valves 65 mm 2½ in. and over: Cast iron body, bronze trim, O.S. and Y, rising stem, solid wedge, flanged ends, rating 860 kPa 125 psi steam. Red-White Fig. 421.

.7 Swing Check Valves up to 50 mm 2 in.: Bronze body, screw-in cap, replaceable disc, 860 kPa 125 psi steam rating. Threaded, Red-White Fig. 236. Solder ends, Red-White Fig. 237.

.8 Swing Check Valves 65 mm 2½ in. and over: Cast iron body, regrind-renew swing check, bolted cover, flanged ends, bronze disc and seat ring, rating 860 kPa 125 psi steam. Red-White Fig. 435.

.9 Silent Check Valves for Pump Discharge:

.10 Up to 50 mm 2 in.: Bronze body, SS stem, 316 SS spring, teflon disc and seat ring, 430 SS seat screw, threaded ends. 1380 kPa 200 psi water. Val Matic VM-S1400.

.11 65 mm 2½ in. and over: Wafer style, cast iron body, 316 SS seat, plug, spring and bushing. ANSI Class 125. Val Matic, Series 1400.

2.3 Domestic Hot Water System

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

2.4 Hot Water Heating Systems

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

.2 Globe Valves up to *50 mm **2 in.***: Bronze body, screw over bonnet, threaded ends rating *1035 kPa **150 psi*** steam, solder ends rating *2070 kPa **300 psi*** water. Threaded, Red-White Fig. 221. Solder ends, Red-white Fig. 222.

.3 Globe Valves *65 mm **2½ in.*** and over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disc. Rating 860 *kPa **125 psi*** steam. *1380 kPa **200 psi*** water. Red-White Fig. 400.

.4 Butterfly Valves: Cast iron wafer full-lug body, 300 Series stainless steel shaft, bronze disc, replaceable EPDM seat, lever lock handle operator with multiple position lock plate for valve sizes to *100 mm **4 in.***, heavy duty gear handwheel operator with position indicator for valve sizes *150 mm **6 in.*** and over. Minimum rating *1200 kPa **175 psi***, *121°C **250°F***. Keystone F1000, F1020.

.5 Gate Valves up to *50 mm **2 in.***: Bronze body, inside screw, travelling stem, solid wedge, screw-in bonnet, threaded ends rating *860 kPa **125 psi*** steam, solder ends rating *1380 kPa **200 psi*** water. Threaded, Red-White Fig. 293. Solder ends, Red-White Fig. 299.

.6 Gate Valves *65 mm **2½ in.*** and over: Cast iron body, bronze trim, O.S. and Y, rising stem, solid wedge, flanged ends, rating *860 kPa **125 psi*** steam. Red-White Fig. 421.

.7 Swing Check Valves up to *50 mm **2 in.***: Bronze body, screw-in cap, replaceable disc, *860 kPa **125 psi*** steam rating. Threaded, Red-White Fig. 236. Solder ends, Red-White Fig. 237.

.8 Swing Check Valves *65 mm **2½ in.*** and over: Cast iron body, regrind-renew swing check, bolted cover, flanged ends, bronze disc and seat ring, rating *860 kPa **125 psi*** steam. Red-White Fig. 435.

.9 Silent Check Valves for Pump Discharge:

.1 Up to *50 mm **2 in.***: Bronze body, SS stem, 316 SS spring, teflon disc and seat ring, 430 SS seat screw, threaded ends. *1380 kPa **200 psi*** water. Val Matic VM-S1400.

.2 *65 mm **2½ in.*** and over: Wafer style, cast iron body, 316 SS seat, plug, spring and bushing. ANSI Class 125. Val Matic, Series 1400.

.10 Eccentric Plug Valves: Cast iron body with resilient faced cast iron plug, bolted bonnet, stainless steel bearings, nickel seat. Multiple packing ring, stem seal and resilient plug facing materials suitable for hot water service to *121°C **250°F.*** Valve ends threaded up to *50 mm **2 in.***, flanged *65 mm **2½ in.*** and over. Lever operator with adjustable open position memory stop up to *100 mm **4 in.*** valves, heavy duty gear reducer handwheel operator with adjustable open position memory stop for valves *150 mm **6 in.*** and over. Rating 1210 *kPa **175 psi*** water at *121°C **250°F***. DeZurik Series 100.

.11 Terminal Heat Transfer Unit Valves up to *30 mm **1 ¼ in.***: Heavy pattern brass body radiator valve, wheel handle, rising stem, inside screw, renewable composition swivel disc, straight or angle globe, threaded or union ends, positive back seating. Dahl Series 11040.

.12 Terminal Heat Transfer Unit Valves *40 mm **1½ in.*** and over: Bronze gate valves, threaded ends up to *50 mm **2 in.***, cast iron gate valves, flanged ends, valve sizes *65 mm **2½ in.*** and over. Red-White Fig. 421.

.13 Terminal Heat Transfer Unit Balancing Valves up to *30 mm **1 ¼ in.***: Removable cap key, screw set memory bonnet for balancing, brass body, rising stem, inside screw, renewable composition swivel disc, straight or angle globe, threaded or union ends, positive back seating. Dahl Series 13000-M.

.14 Terminal Heat Transfer Unit Balancing Valves *40 mm **1½ in.*** and over: Eccentric plug valve, as described above.

.15 Drain Valves up to *50 mm **2 in.***: Brass 2 piece body ball valve, blowout proof stem, teflon seats, forged brass chrome palted ball, hose end connection with cap and chain by male IP, *4200 kPa **600 psi*** water, oil, gas rating, Red-White Fig. 5046.

.16 Terminal unit brass T-body drain valve, wheel handle, ground body-bonnet joint, renewable disc, brass chain, forged brass gasketed cap. Working pressure *1725 kPa **250 psi*** at *121°C **250°F***. Dahl 21.616.

.17 Circuit Balancing Valves: Suitable for throttling. All metal parts non-ferrous, die cast non-porous copper alloy. Flow measuring accuracy ±2%. Positive shut-off, drain connection with cap. Memory balancing feature. Fittings for connection of portable differential pressure meter. Bell & Gosset circuit setter.

2.5 Valve Operators

.1 Provide suitable hand wheels for gate, globe or angle, radiation and drain valves and inside hose bibbs.

.2 Provide one plug cock wrench for every ten plug cocks sized *50 mm **2 in.*** and smaller, minimum of one. Provide each plug cock sized *65 mm **2½ in.*** and larger with a wrench, with set screw.

.3 Provide valves larger than *100 mm **4 in.*** located more than *2.1 m **7 ft.*** from floor in equipment rooms with chain operated sheaves. Extend chains to *1.5 m **5 ft.*** above floor and hook to clips to arrange to clear walking aisles.

2.6 Strainers

.1 Size *50 mm **2 in.*** and under: Screwed brass or iron body, Y pattern with *0.75 mm **24 ga.*** stainless steel perforated screen.

.2 Size *65 mm to 100 mm **2½ in. to 4 in.***: Flanged iron body, Y pattern with 1 *mm **20 ga.*** stainless steel perforated screen.

.3 Size *125 mm **5 in.*** and larger: Flanged iron body, Y pattern with *3 mm **11 ga.*** stainless steel perforated screen.

.4 Screen free area shall be minimum three times area of inlet pipe.

2.7 Triple Duty Valve

.1 For base mounted or vertical inline pump discharge application, performs the functions of a non-slam check valve, throttling valve, shut-off valve and calibrated balancing valve. Equip with brass readout valves (with integral check valves) to read differential pressure across valve.

.2 Cast iron, bronze seat, replaceable bronze disc with EPDM insert.

.1 Up to *50 mm **2 in.***: NPT connections, *1200 kPa **175 psi*** working pressure, brass stem, chatter preventing SS spring.

.2 Over *50 mm **2 in.***: Flanged connections, *860 kPa **125 psi*** rated, stainless steel stem and chatter preventing spring.

2.8 Suction Diffuser

.1 For base mounted or floor mounted vertical inline pumps where scheduled.

.2 Cast iron construction; NPT connections up to *50 mm **2 in.***: flanged connections.

.3 Over *65 mm **2½ in.***: cast iron straightening fitting, stainless steel combination diffuser - strainer - orifice cylinder with *4.8 mm **3/16 in.*** perforations, and permanent magnet. Provide complete with a 16 mesh bronze strainer.

3. EXECUTION

3.1 Installation and Application

.1 Install valves with stem upright or horizontal, not inverted.

.2 Provide threaded lug type butterfly valves for equipment isolation service. Provide wafer or threaded lug type valves for zone shut-off service.

.3 Where permitted by codes, butterfly valves may be used in fire protection systems.

.4 Use eccentric plug valves in water systems for throttling/balancing service.

.5 Use memory radiator balancing valves in water systems terminal heat transfer unit balancing service. For radiant panels provide "circuit setter" valves on return line for each central zone; and a ball valve for shut off service.

.6 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.7 Size drain lines and drain valves equal to size of apparatus drain connection.

.8 For pipe sizes *20 mm **3/4 in.*** and over, minimum drain size to be *20 mm **3/4 in.***

.9 Provide hose thread connection with cap and chain for *20 mm **3/4 in.*** drain valves located in ceiling and public areas.

.10 Provide male NPT nipples with threaded pipe cap for drain sizes over *20 mm **3/4 in.*** where not piped directly to floor drains.

.11 Provide valved drain and hose connections off the bottom of all strainers.

.12 Install gate or ball valves for shut off and isolating service, to isolate equipment, part of system, and vertical risers. Ball valves shall be used up to and including 50 mm.

.13 Install globe valves for throttling in steam system in sizes 150 mm and larger.

.14 Install globe or angle valves for throttling service and control device or meter bypass.

.15 *Provide spring loaded check valves on discharge of condensate pumps, condenser water and water booster pumps

.16 Use plug cocks in water system for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

.17 *Use butterfly valves in heating water systems (and chilled and condenser water systems), interchangeably in place of gate valves on all piping 65 mm and larger.

.18 *Use butterfly valves in fire protection systems where approved. Use OS&Y gate valves on inlet side of fire and jockey pumps and for window deluge systems.

.19 Provide gate or ball valve in hot and cold water lines serving a male or female washroom group of fixtures at each hose bibb and at all equipment requiring isolation.

.20 Use bronze body ball valves for domestic water service.

.21 Provide valves upstream of all meters, gauges, automatic air vents, etc. for isolation purposes.

.22 Run line size pipe to floor drains from all drain cocks, drain valves, etc.

.23 Provide main piping system drain valves as a low point and pipe to drain. Drain valves shall be 2 pipe sizes smaller than largest mains and minimum 25 mm.

.24 Provide 50 mm globe by-pass valves around steam isolation valves 150 mm and larger.

.25 Provide isolation valves in all systems such that floor by floor for horizontal systems, all risers in a vertical system and zone areas on a large horizontal system can be isolated.

.26 Spring loaded water check valves shall be located 8 pipe diameters downstream of pumps or elbows.

3.2 Valve Connections

.1 Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.

.2 Thread pipe sizes 50 mm and smaller.

.3 Flange pipe sizes 65 mm and larger.

.4 Solder or screw to solder adapters for copper tubing.

.5 Use grooved body valves with mechanical grooved jointed piping.

.6 Provide butterfly valves with tapped lug body when used for isolating service.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Piping insulation for heating and domestic water system.

.2 Adhesives, tie wires, tapes.

.3 Recovering.

1.2 Quality Assurance

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 The British Columbia Insulation Contractors Association (BCICA) Quality Standards Manual for Mechanical Insulation, 1993 Edition together with authorized additions and amendments, shall be used as a reference standard and form part of this project specification.

.3 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.

.4 Insulation will meet ASHRAE Standard 90.1 2004.

1.3 Submittals

.1 Submit shop drawings which indicate complete material data, “K” value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

.2 Submit samples of proposed insulating and recovering materials.

1.4 Job Conditions

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer’s density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.5 Alternatives

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

2. PRODUCTS

2.1 Approved Manufacturers

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

2.2 General

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

.2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

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

2.3 Materials

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

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

3. EXECUTION

3.1 Preparation

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation

.1 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.

.2 Insulate complete system including fittings, valves, unions, flanges, strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with plastic material travelled on a bevel. Alternative from insulating these devices, coat hot systems with Robson “Thermalite” and cold systems with Robson “No Sweat – Fx”.

.3 Insulate piping, fittings and valves. Do not insulate unions, flanges (except on flanged valves), “victaulic” couplings, strainers, (except on chilled water lines), flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.4 Finish insulation neatly on hangers, supports and other protrusions.

.5 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.

.6 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, pipe shafts and suspended ceiling spaces is not considered exposed. Make smooth uneven insulated surfaces before recovering.

.7 Cover insulation exposed to outdoors with aluminum jacket secured with aluminum bands on 200 mm (8 in.) centres or screws on 150 mm (6 in.) centres. Lap joints 75 mm (3 in.) minimum and seal with compatible waterproof lap cement.

.8 Cold Piping: Seal lap joints with 100% coverage of vapour barrier adhesive. Seal butt joints with 50 mm (2 in.) wide strips of vapour barrier sealed with vapour barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.

.9 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm (4 in.) centres.

.10 Hot Piping: For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells.

3.3 Insulation Installation Thickness Schedule

	Piping or Equipment	Pipe Sizes *mm/in.*	Insulation Thickness *mm/in.*	Recovery Jacket
.1	Heating system Piping	All sizes	*40/1½*	Canvas / PVC
.2	Domestic water piping	All sizes	*40/1½*	Canvas / PVC

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 Duct thermal insulation.

.2 Duct acoustic insulation.

.3 Breeching insulation.

.4 Adhesives, tie wires, tapes.

.5 Recovery.

.6 All outdoor mounted ductwork.

1.2 Quality Assurance

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 The British Columbia Insulation Contractors Association (BCICA) Quality Standards Manual for Mechanical Insulation, 1993 Edition together with authorized additions and amendments, shall be used as a reference standard and form part of this project specification.

.3 Materials shall meet fire and smoke hazard ratings as stated in this section and defined in applicable current building codes.

1.3 Submittals

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

.2 Submit samples of proposed insulating materials and recovering.

1.4 Job Conditions

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement, poor workmanship or material defects.

1.5 Alternatives

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

2. PRODUCTS

2.1 Approved Manufactures

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

2.2 General

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

.2 Insulating materials and accessories shall withstand service temperatures without smouldering, glowing, smoking or flaming.

.3 Recovery Jackets:
: *ULC labelled thermo-canvas.

: *0.5 mm **(26 ga.)** *smooth *embossed aluminum sheet.

: *0.9 mm **(20 ga.)** *smooth *embossed aluminum sheet for Exterior duct work where subject to damage]

.4 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

2.3 Materials

.1 Exposed Rectangular Ducts: Rigid fibrous glass or mineral fibreboard insulation, "K" value maximum *0.035 W/m.°C* ***(0.25 Btu-in./hr.ft^2.°F)*** at *24°C* ***(75°F)***. Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature *20°C* ***(68°F)*** to *65°C* ***(150°F)***. Cold ducts service temperature *-40°C* ***(-40°F)*** to *65°C* ***(150°F)***.

.2 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass or mineral fibre insulation, "K" value maximum *0.035 W/m.°C* ***(0.25 Btu-in./hr.ft^2. °F)*** at *24°C* ***(75°F)***. Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature *20°C* ***(68°F)*** to *65°C* ***(150°F)***. Cold duct service temperature *-40°C* ***(-40°F)*** to *65°C* ***(150°F)***.

.3 Acoustic Lining: Fibrous glass or mineral fibreboard insulation with "K" value maximum *0.035 W/m.°C* ***(0.25 Btu-in./hr.ft^2.°F)*** at *24°C* ***(75°F)***. Absolute roughness of exposed surface not to exceed *0.58 mm* ***(0.02 in.)***, coated to prevent fibre erosion at air velocities up to *25.4 m/s* ***(5,000 fpm)***, *24 kg/m³* ***(1.5 lb/ft^3)*** minimum density for ductwork and *75 kg/m³* ***(4.7 lb/ft^3)*** for plenums. Substrate must not be dark in colour. Service temperature *-40°C* ***-(40F)*** to *65°C* ***(150°F)***.

.4 Breeching Insulation: Semi-rigid mineral fibre insulation with glass mat "K" value *0.035 W/m.°C* ***(0.25 Btu-in/hr.ft^2°F)*** maximum at *24°C* ***(75°F)***. Service temperature *65°C* ***(150°F)*** to *450°C* ***(842°F)***.

3. EXECUTION

3.1 Preparation

.1 Do not install covering before ductwork and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions where possible.

3.2 Installation

.1 Ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation materials, properly sealed.

.2 Finish insulation neatly at hangers, supports and other protrusions.

.3 Do not insulate ductwork with external thermal insulation where acoustic duct insulation is specified.

.4 Locate insulation or cover seams in least visible locations. Locate seams on ductwork in ceiling spaces on the underside of the duct.

.5 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Make smooth any uneven insulated surface before recovering.

.6 Cover insulation exposed to outdoors with aluminum jacket secured with aluminum bands on *200 mm* ***(8 in.)*** centres or screws on *150 mm* ***(6 in.)*** centres. Lap joints *75 mm* ***(3 in.*** minimum and seal with compatible waterproof lap cement.

.7 Exposed Rectangular Ducts: Secure rigid insulation with galvanized anchors or welded pins on *400 mm* ***(16 in.)*** centres. Secure in place with retaining pins. Seal all insulation joints and breaks with joint tape. Seal adhesive; cover joints with *100 mm* ***(4 in.)*** strips of open mesh cloth imbedded between two coats of lap seal adhesive. Use vapour barrier tape for insulation joints or breaks on cold ducts.

.8 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in *150 mm* ***(6 in.)*** wide strips on *400 mm* ***(16 in.)*** centres. Provide annealed tie wire tied at *400 mm* ***(16 in.)*** centres for securing duct insulation. Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape. Use vapour barrier tape for cold ducts.

.9 Acoustic Lining: Apply to interior of ducts where shown. Secure to ductwork with adhesive using 50% coverage and anchors or weld pins on *400 mm* ***(16 in.)*** centres. Secure in place with retaining clips. Cut off excess fastener length and cover with brush coat of mastic over protrusions and all raw edges. Use *25 mm* ***(1 in.)*** thick insulation unless otherwise noted. Provide vapour barrier located on the warm side for outside air intakes. Bevel corners at joints and butt together. Install acoustic gauze over all cut corners and joints and brush coat with lap seal adhesive.

.10 Where duct velocities exceed *15 m/s* ***(3,000 fpm)***, cover internal duct insulation with *0.8 mm* ***(22 ga.)*** perforated galvanized steel with 24% free area.

.11 Breeching Insulation: Face breeching with *9.5 mm* ***(0.37 in.)*** rib lath turn out to provide *12 mm* ***(0.5 in.)*** space between insulation and hot surface and *12.5 mm* ***(0.5 in.)*** mesh expanded lath on the outside. Butt blankets firmly together and secure with *1.6 mm* ***(16 ga.)*** galvanized wire. Lace metal mesh together. Coat with *12 mm* ***(0.5 in.)*** thick insulating cement. Finish with a final *12 mm* ***(0.5 in.)*** coat of insulating cement. Trowel to a smooth hard finish. Recover with aluminum jacket.

.12 Fasten aluminum recovery jacket in place with aluminum banding on *200 mm* ***(8 in.)*** centres or screws or rivets on *150 mm* ***(6 in.)*** centres.

3.3 Insulation Installation Thickness Schedule

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

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 Hot - valves, strainers, flow meters, control valves, valves, pump housings, domestic hot water heat exchangers, other heat exchangers, expansion joints, expansion compensators, etc.

.2 Other equipment being part of this project scope of work.

1.2 Quality Assurance

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.

1.3 Submittals

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

.2 Submit samples of proposed insulating and recovering materials.

1.4 Job Conditions

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.5 Alternatives

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

2. PRODUCTS

2.1 General

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

.2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

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

2.2 Materials

.1 Hot Equipment: Rigid fibrous glass or mineral fibre insulation, "K" value maximum 0.035 W/m.°C (0.25 Btu-in/hr-ft2-°F) at 24° (75°F). Service temperature -14°C (7°F) to 200°C (392°F).

.2 Provide velcro or zippered removable insulation coverings over equipment access ports, controls devices and connection fittings. Do not insulate over nameplates or other data plates. Finish all exposed edges to the exterior insulation finish specified

.3 Recovery Jackets:

.1 *ULC labelled thermo-canvas flamespread less than 25 smoke developed less than 50.

.4 Insulation: TIAC Code C.2 Flexible Mineral Fibre Blanket for Medium and High Temperature Applications (Removable Thermal Blanket Insulation)

.1 Secondary Piping, all types, mechanical rooms.

.2 Materials

.1 Asbestos-free removable thermal blanket insulation to withstand temperatures up to 150°C (320°F)

.2 Minimum 50mm thickness

.3 Install insulation in sewn blanket coverings

.4 Design to allow for easy removal and reinstallation of same covering

.5 Mineral fibre: to CAB/ULC-S702, ASTM C 547

.6 Jacket: to CGSB 51-GP-52Ma

.7 Maximum “k” factor: to CAN/ULC-S702, ASTM C 547

.8 Acceptable Materials:

.1 Firwin Corporation

.2 INSULTECH®

.3 KeyMay Industries

3. EXECUTION

3.1 Preparation

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation

.1 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, pipe shafts and suspended ceiling spaces is not considered exposed. Make smooth uneven insulated surfaces before recovering.

.2 Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by metal bands. Where necessary, weld on suitable anchors. Provide sufficient clearance around openings for normal operation of equipment. Make uneven surfaces smooth with insulating cement.

3.3 Insulation Thickness

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 Only tested firestop systems shall be used in specific locations as follows:

.2 Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

.3 Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

1.2 Quality Assurance

.1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

.2 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer’s products per specified requirements. A manufacturer’s willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

.3 Firestop System installation must meet requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating.

.4 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

.5 Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

.6 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

1.3 Reference Standards

.1 Test Requirements: ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops".

.2 CAN4-S115-M under their designation of ULC-S115-M.

.3 Inspection Requirements: ASTM E 2174 – 01, “Standard Practice for On-site Inspection of Installed Fire Stops.

.4 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 All major building codes: NBC, and BCBC.

.6 NFPA 101 - Life Safety Code

1.4 Submittals

.1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 15010.

.2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineer judgment must include both project name and contractor's name who will install firestop system as described in drawing.

.3 Submit material safety data sheets provided with product delivered to job-site.

1.5 Job Conditions

.1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.

.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

.3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

.5 Do not use damaged or expired materials.

1.6 Approved Manufacturers:

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

2. PRODUCTS

2.1 General

.1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

.3 Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

2.2 Materials

.1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.2 Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:

.1 Hilti CP 680 Cast-In Place Firestop Device

.1 Add Aerator adaptor when used in conjunction with aerator ("sovent") system.

.2 Hilti CP 681 Tub Box Kit for use with tub installations.

.3 Hilti CP 682 Cast-In Place Firestop Device for non-combustible pipe

.4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory

.3 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant

.2 Hilti CP 604 Self Leveling Firestop Sealant

.3 Hilti CP 620 Fire Foam

.4 Hilti CP 606 Flexible Firestop Sealant

.5 Hilti CP 601s Elastomeric Firestop Sealant

.6 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory

.4 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant

.2 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory

.5 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential, the following products are acceptable:

.1 Hilti CP 643N Firestop Collar

.2 Hilti CP 644 Firestop Collar

.3 Hilti CP 645/648 Wrap Strips

.4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory

.6 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, the following products are acceptable:

.1 Hilti CP 637 Firestop Mortar

.2 Hilti FS 657 Fire Block

.3 Hilti CP 620 Fire Foam

.4 Hilti CP 675-T Firestop Board

.5 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory

.7 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:

.1 Hilti FS 657 Fire Block (for walls and floors)

.2 Hilti CP 658T Firestop Plug (for walls and floors)

.3 Hilti CP 680 Cast-In Place Firestop Device (for floors only)

.4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory

.8 For penetrations through a Fire Separation wall provide a firestop system with a "F" Rating as determined by ULC or cUL as indicated below:

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

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

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

3. EXECUTION

3.1 General

.1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

.2 Verify penetrations are properly sized and in suitable condition for application of materials.

.3 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.4 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

.5 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

.6 Do not proceed until unsatisfactory conditions have been corrected.

3.2 Coordination

.1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

.2 Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.3 Installation

.1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.

.3 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

.4 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

.5 Protect materials from damage on surfaces subjected to traffic

END OF SECTION

1. GENERAL

1.1 Scope

.1 Cleanouts.

.2 Air chambers or water hammer arresters.

.3 Roof and floor drains.

.4 Cooling equipment condensate drains.

.5 Backflow preventers.

.6 Vacuum breakers.

.7 Backwater valves.

1.2 General Requirements

.1 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes and as specified herein.

.2 Provide water and drainage connections to equipment furnished in other sections of this specification and as supplied by the Owner.

1.3 Submittals

.1 Submit shop drawings for review by the Consultant, in accordance with the general conditions. Provide shop drawings for the all applicable following items:

.1 Roof and Floor Drains

.2 Backflow preventers

.3 Vacuum Breakers

2. PRODUCTS

2.1 Approved Manufactures

.1 Backflow Preventers: Febco, Watts, Hersey, Singer, Ames.

.2 Drains: Zurn, Ancon, PPP, J.R. Smith.

.3 Hose Bibbs: Jenkins, Dahl, Crane, Toyo, Kitz, Mifab.

.4 Meters Positive Displacement: Neptune, Rockwell.

2.2 Clean-Outs and Clean-Out Access Covers

.1 Provide caulked or threaded type extended to finished floor or wall surface. Provide bolted coverplate clean-outs on vertical rainwater leaders only. Ensure ample clearance at clean-out for rodding of drainage system.

.2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Provide round access covers in finished areas with depressed centre section to accommodate floor finish. Wall cleanouts to have chrome plated caps.

.3 Supply and install cleanouts on all drains at all changes in direction, at the ends of all horizontal runs, at the base of every stack where drain leave the building; where shown on the drawings, 7.6 m apart in horizontal drainage lines of 50 mm and 65 mm nominal diameter, 15.2 m apart in horizontal lines of 75 mm or 100 mm nominal diameter and not more than 30 m apart for larger pipe sizes and as called for in the British Columbia Plumbing Code.

.4 All outside cleanouts shall be extended to grade in cast iron. They shall be sufficiently anchored in a 300 mm x 300 mm x 100 mm thick concrete block of concrete to prevent rotation of the pipe. Concrete work shall be provided and installed by the General Contractor.

.5 All cleanouts shall be full size for pipes up to 100 mm diameter and 100 mm size for larger pipes. Cleanouts shall be extended to a finished wall or floor. No cleanouts shall terminate at the ceiling of a room, sanitary and storm shall be extended to the floor above. Cleanouts shall not terminate in the floor of any sterile rooms.

.6 The piping shall be extended beyond the room for cleanout installation. Where cleanouts occur in carpeted areas, they shall be extended to the finished walls unless the Consultant gives special permission for them to terminate the carpeted floor. In potentially wet areas such as washrooms, cleanouts shall be extended to the walls wherever possible. Where conditions do not permit wall cleanouts, the cleanout cover shall be waterproof, Jay R. Smith 4020-F-C with nickel bronze frame and cover and integral waterproofing clamping collar. All cleanouts passing through walls or floors with a waterproofing membrane shall have a clamping collar which shall be clamped to the membrane.

.7 Cleanouts for copper pipe shall be cast brass, Crane 1816, 1817 or Emco 57-18190 with raised shoulder on plug and gasket.

.8 Cleanouts for cast iron pipe shall be steel plug type, Associated Foundry.

.9 Cover for cleanouts shall be as follows:

.1 Unfinished areas, such as concrete floors in equipment rooms and flush type C.O. in outside areas, Jay R. Smith 4220 with extra heavy duty adjustable cast iron cover suitable for heavy traffic.

.2 Finished floors Jay R. Smith 4100 heavy duty with adjustable N.B. frame and cover.

.3 Finished floors pedestrian duty only Jay R. Smith 4020 medium duty with adjustable N.B. frame and cover.

.4 Floors finished in lino or other such thin material Jay R. Smith 4140 round with adjustable N.B. frame and cover.

.5 Walls finished with ceramic tile, Acudor UF5000 stainless steel access door.

.6 All painted walls, provide prime coated covers as specified for access panels with minimum clear opening of 200 mm x 200 mm for cleanouts 50mm and smaller 300 mm x 300 mm for cleanouts larger than 50 mm. Avoid covers on feature walls; i.e.: wood panels. If unavoidable, the covers shall be for painted walls but with finish material secured to the cover to the satisfaction of the Consultant and finished flush with wall. In all sterile areas provided stainless steel finish on all access panel. All cleanouts shall have locations clearly indicated.

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

2.3 Water Hammer Arresters

.1 Fit water supply to each fixture or group of fixtures with an air chamber. Provide air chambers same size as supply line or *20 mm* ***3/4 in.*** minimum, and minimum *450 mm* ***18 in.*** long.

.2 Install stainless steel bellows type water hammer arresters on water lines connected to solenoid valves [, flush valves] [and to fixture or group of fixtures] complete with accessible isolation valve.

2.4 Roof Drains

.1 Flow Characteristics: [Full open flow.] [Controlled flow].

.2 Material: All major components including body, flashing clamping flange, under deck clamping ring and dome strainer shall be cast iron or cast aluminum, lacquered. Bolts shall be galvanized or prime painted steel.

.3 Body:

.1 Sump: minimum 180 mm 7 in. internal diameter, minimum 75 mm 3 in. deep.

.2 Discharge: nominal 100 non-threaded MJ.

.3 Bosses: solid, integrally cast, for under deck clamping ring and flashing flange bolts.

.4 Deck flange: nominal 300 mm 12 in. outside diameter, minimum 50 mm 2 in. width.

.4 Flashing Clamping Flange: Outside diameter same as outside diameter of deck flange; Vnotched positive draining gravel stop lip, *15 mm* ***1/2 in.*** high.

.5 Dome Strainer: Minimum *150 mm* ***6 in.*** high; *8 mm* ***0.3 in.*** to *15 mm* ***1/2 in.*** slotted openings, sides and top.

.6 Example Spec's

.1 RD-1: Conventional roof drains: Jay R. Smith 1010Y-ERC-CIUD, Duco 375 mm dia. cast iron body, with membrane clamp collar and cast iron dome, fixed extension to suit insulation thickness, under deck clamp and sump receiver.

.2 RD-2: Insulated roof membrane assembly (inverted) roof drains: Jay R. Smith 1011Y-RC-CID, Duco 375 mm dia. cast iron body, with membrane clamp collar and cast iron dome, stainless steel drainage grid, under deck clamp and sump receiver.

.3 RD-3: Promenade deck drains: Jay R. Smith 1330DS-RC, Duco 200 mm dia. cast iron body, with membrane clamp collar, perforated stainless steel drainage extension to suit insulation and/or drainage coarse thickness, adjustable 200 mm square nickel bronze strainer, under deck clamp and sump receiver.

2.5 Floor Drains

.1 Floor drains shall have lacquered cast iron body with double drainage flange, weep holes combined two piece body reversible clamping device and adjustable nickel/bronze strainer. Shower and washroom floor drains shall have a removable perforated sediment bucket.

.2 Floor drains in equipment rooms shall have polished bronze funnel type strainer [, and extension for floating floor.]

.3 Floor drains for warehouses and vehicle areas shall have lacquered extra heavy duty type drain body with 300 x 300 hinged grate and sediment bucket. The entire drain assembly, body, sump, and grate shall be factory coated with 3 M Scotchkote 206 standard for fusion bonded epoxy coating. Ancon FD-460AF.

2.6 Area Drains

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

2.7 Equipment Drains

.1 Provide a sloped connection from packaged equipment drain pans to nearest sanitary sewer trapped connection. Slope at minimum of 0.5% grade. Drains size to be **20 *25 mm **3/4*1*in.*** complete with *100 mm **4 in.*** deep trap at unit.

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

2.8 Backflow Preventer Assemblies

.1 Provide backflow preventer assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall meet current AWWA requirements and CSA B64 standards.

.2 Provide complete reduced pressure principle type assembly, consisting of pressure differential relief valve, located between two (2) positive seating replaceable check valves with stainless steel or bronze seats Watts No. 909. Provide strainer between gate valve and first check valve on units *50 mm **2 in.*** and smaller.

.3 Provide complete double check valve type assembly consisting of two (2) positive sealing replaceable check valves with stainless steel or bronze seats. Provide check valve on units *50 mm **2 in.*** and smaller. Watts No. 709.

.4 Provide complete atmospheric vent backflow preventer assembly, consisting of two (2) positive sealing replaceable check valves with bronze seats, integral stainer and threaded vent connection. Watts No. 9D.

2.9 Vacuum Breaker Assemblies

.1 Provide pressure type vacuum breaker assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall consist of one (1) positive sealing check valve and one (1) atmospheric vent disk with stainless steel or bronze seats complete with shut-off valves before and after check valves and test cocks. Assembly shall meet AWWA requirements and CSA B64 standards. Watts No. 800.

.2 Provide atmospheric type vacuum breaker assembly complete with shut-off valve before assembly. Assembly shall consist of one (1) free floating poppet to seal the atmospheric vent under flow conditions. Watts No. 288A. For bottom inlet and outlet, Watts No. 388ASC.

.3 Provide hose connection type vacuum breaker assembly, consisting of a check valve disc assembly to be vandal proof and drainable. Watts No. 8A. For freezing conditions, Watts No. NF8.

2.10 Backwater Valve Assemblies

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

2.11 Trap Seal Primers

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

2.12 Pressure Reducing Valves

.1 *25 mm* ***1 in.*** and smaller: Bronze body, SS integral strainer, renewable SS seat, high temperature rated diaphragm suitable for hot or cold water. Rated at maximum inlet pressure of *2100 kPa* ***300 psi***, maximum reduced pressure *175 kPa* ***25 psi***, maximum temperature *90°C* ***194°F***.

.2 *30 mm* ***1¼ in.*** and larger: Pilot operated, cast iron body, modified globe design, threaded ends to *50 mm* ***2 in.***, flanged ends *65 m* ***2½ in.*** and larger. Maximum inlet pressure **1225 kPa *2100 kPa* ****175 psi*300 psi***. Maximum temperature *90°C* ***194°F***. Bronze trim. Pilot control system: bronze with SS trim, hydraulically operated, diaphragm actuated.

.3 Size to suit flow capacities and service.

.4 Provide with gate valve and union on inlet and outlet, globe valve bypass, pressure gauge on inlet and outlet and pressure relief valve on reduced pressure side.

3. EXECUTION

3.1 Installation

.1 Bury outside water and drainage pipe minimum [*1200 mm* ***4 ft.***] [*1800 mm* ***6 ft.***], unless noted otherwise.

.2 Lubricate clean-out plugs with mixture of graphite and linseed oil. Prior to building turnover remove clean-out plugs, re-lubricate and reinstall using only enough force to ensure permanent leak-proof joint.

.3 Where floor drains are located over occupied areas, provide waterproof installation.

.4 Drainage lines shall grade *2 mm* ***2 in.*** per *100 mm* ***100 in.*** unless otherwise indicated on drawings.

.5 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to *550 kPa* ***80 psi***.

.6 Locate plumbing vents minimum *5 m* ***16 ft.*** from air intakes.

.7 Provide PRV in hot water supply to dishwashers.

.8 Provide a heat trap loop in domestic hot water supply piping at domestic hot water storage tanks.

.9 Install cast iron connections from weeping tile to storm drainage system including backwater valve, and cleanout. Provide access for servicing of backwater valve.

.10 Provide and install valved connections on hot and cold water lines to each hot water tank complete with vacuum breakers on cold water make-up and temperature pressure relief valve.

.11 Install vacuum breakers or backflow preventers to AWWA standards on plumbing lines where contamination of domestic water may occur. Generally necessary on boiler make-up lines, hose bibbs and flush valves. All backflow preventers shall be installed at a maximum 1500 mm above the floor or ground level.

.12 Install trap primer on all drains which do not receive water daily. Primers shall be installed in an area accessible for easy maintenance.

.13 Provide seismic restraints for tanks and all high centre of gravity equipment.

.14 All R.P. device backflow preventers shall be provided with daylight type drainage or full flow piping drain line or sump.

.15 Do not run any wet piping through electrical machine rooms or other similar rooms.

.16 Provide pump out drains in all elevator pits

.17 Provide dielectric fittings in all dissimilar metal connections.

3.2 Excavation & Backfilling

.1 Provide any excavations necessary for the installation of the mechanical work. No cutting, boring or excavating necessary for this work in or about the building which may cause interference with the progress of the work or weaken the structure in any way, shall be undertaken without the approval of the Consultant before commencing work. Trenches or tunnels for all underground piping shall be excavated to a depth slightly more than required and graded so as to secure all available fall. Support each length of pipe with concrete blocks and bricks, or backfill the trench with gravel to the required depth and grade. Sanitary and storm lines outside of the building shall be kept as deep as practical. See Section 02200 for excavation requirements.

.2 Backfilling in all trenches shall be with sand or pea gravel where approved, 150 mm below pipe and up to 150 mm (6”) over top of piping, then flushed with water so as to ensure the total length of each pipe is resting on solid footing. Remainder of all trenches shall be filled by the General Contractor. See Section 02200 for backfilling requirements. Where sewer, water or storm pipes pass under a grade beam or footing the trench around the piping up to and in contact with the footing, provide a 450 kg concrete grouting so as to seal the outside trenching from normal storm runoff and backflow of rain water through the trenching and into the crawl space and/or under the basement floor.

.3 Where sewer, water or storm pipes pass through exterior walls below grade, the General Contractor shall install corbels on the exterior walls and run bridging from corbel to undisturbed soil for the support of the pipes. One inch thick waterproof mastic shall be applied around the pipes which pass through the wall.

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 The entire building shall be fully sprinklered.

.2 Provide a complete sprinkler system as required by current building codes. Provide piping, sprinkler heads, alarm check valve, zone valves, excess pressure pump and all other devices and accessories required to provide a completely functional system.

.3 Tender documents do not contain complete sprinkler drawings. The sprinkler contractor shall prepare his own drawings. Where sprinkler head locations are shown, this is to indicate general intent only. It is the responsibility of the contractor to allow for in his bid and to install all heads required to satisfy the code. In laying out sprinkler system, the contractor shall review the contract documents and site conditions to ensure that piping systems do not conflict with other building elements. Any serious interferences shall be reported to the consultant prior to commencement of work.

.4 Sprinkler system shall be hydraulically designed by the sprinkler subtrade with shop drawings (sealed and signed by a professional engineer practicing in the Province of BC and assuming full responsibility for the installed system) submitted showing all piping and sprinkler head locations. The contractor shall submit detailed installation drawings and design calculations for approval to the authorities having jurisdiction and to the Consultant to review, prior to commencing work. No work shall commence prior to obtaining approved drawings from authorities having jurisdiction. The sprinkler contractor shall supply letters of assurance for the fire protection systems, and submit same to the Consultant as well as the local authorities.

.5 Contractor to confirm the flow and pressure available by conducting a hydrant flow test. Sprinkler system design to be based on the final flow test information.

.6 Provide dry sprinkler systems/heads in areas subject to freezing temperature.

.7 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the seismic restraints.

.8 Provide these letters of assurance sealed by a registered professional engineer for the seismic restraints, “Assurance of Professional design and commitment for field review” as well as “Assurance of Professional field review and compliance”.

1.2 General Requirements

.1 Run piping concealed above furred ceilings and in joist to minimize obstructions. Expose only heads.

.2 A combined sprinkler - standpipe is to be provided. Refer to Section 15520 for Standpipe Specifications.

.3 Prior to preparing shop drawings, sprinkler contractor shall review contract drawings of all disciplines and site conditions to ensure the piping systems do not conflict with other building systems. Report any serious interferences to engineer prior to commencement of work.

.4 All inspections and tests required by the Authorities shall be arranged and paid for by the contractor.

1.3 Quality Assurance

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

.2 Sprinkler equipment shall be installed by qualified Contractors licensed and regularly engaged in the installation of automatic fire sprinkler equipment.

.3 Equipment and installation shall meet the requirements of current edition of NFPA No. 13 - Standard for the Installation of Sprinkler Systems.

.4 Shop drawings shall include detailed installation drawings showing all piping and sprinkler head locations and design calculations outlined in NFPA 13.

.5 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the Fire Protection Design.

.6 Provide these letters of assurance sealed by a registered professional engineer for the Fire Protection, “Assurance of Professional design and commitment for field review” as well as “Assurance of Professional field review and compliance”.

1.4 Submittals

.1 Submit preliminary layout showing only head locations for review by the Architect and Consultant. Refer to architectural plans for ceiling coordinated head locations, space all others to Code Standards.

.2 Submit shop drawings of entire sprinkler system after review of head locations, for approval by the Underwriters. Submit only Underwriter approval drawings to the Consultant.

.3 No work shall commence prior to obtaining approved drawings from Authorities and Owners Underwriter.

.4 Submit sample of all type of sprinkler heads to be used for review.

2. PRODUCTS

2.1 Sprinkler Head

.1 Temperature rating on fusible links shall suit specific hazard area with minimum margin of safety *10°C **18°F***.

.2 All sprinkler heads shall be of quick response type, having a response time between 30 to 90 seconds.

.3 For suspended ceilings, provide *standard *recessed *semi-recessed pendant type with *brass *chrome plated finish and escutcheon.

.4 For exposed areas, provide standard upright type with *brass *chrome plated finish. For sidewall application, provide sidewall type with *brass *chrome plated finish and escutcheon.

.5 For the pool and chemical storage rooms, provide upright-type rated for a corrosive environment.

.6 For steam and sauna rooms, provide a high temperature-type rated for a humid environment.

2.2 Sprinkler Valve

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

2.3 Excess Pressure Pump

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

2.4 Air Compressor

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

2.5 Siamese Fire Department Connection

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

.2 Siamese fire department connection for sprinkler system shall match connection for standpipe and hose system.

3. EXECUTION

3.1 Installation

.1 Protect sprinkler heads against mechanical injury with standard guards when necessary.

.2 Locate outside alarms on walls of building adjacent to siamese fire department connection.

.3 Provide on wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and a wrench suitable for each head type. Six (6) extra sprinkler heads for less than 300 sprinklers, 12 for 300 to 1000 sprinklers, and 24 for over 1000 sprinkler heads of each type.

.4 Provide *25 mm **1 in.*** diameter nipple and *25 mm x 15 mm **1 in. x 1/2 in.*** reducing fitting for each upright head.

.5 Provide on sprinkler system take-off from water supply approved double check valve assembly with approved listed OS & y gate valves on both sides.

.6 All sprinkler system isolation valves shall have contacts so that they can be monitored on the building fire alarm systems.

.7 Centre heads in two directions in ceiling tile. Maintain code required spacing.

.8 Locate zone shut-off valves visible from the floor. Do not conceal from view, locate in janitor, storage rooms, or stairwells as accepted by the Consultant.

.9 Install all piping to minimize drops and furring requirements.

.10 Arrange sprinkler piping and provide drain valves such that it is completely drainable. Extend drain lines to an accessible location above ceiling over housekeeping areas. Provide valved hose connection and access panel.

.11 Provide sprinkler flow test connections as per NFPA 13.

.12 Provide seismic restraints as required by NFPA-13, and Section 15050 of this specification.

.13 Allow for additional sprinkler heads in mechanical rooms to accommodate field conditions.

.14 Install approved monitored valves and flow switches for all zones. Monitored valves and flow switches shall be wired to central fire alarm system by Division 16. Identify each valve by indicating which portion of the system is controlled by each valve.

.15 All sprinkler head locations shall be coordinated with the lighting, audio equipment, and all other obstacles on the ceilings.

.16 Adjust sprinkler piping up or down if conflictions occur between structure, lighting, electrical, plumbing piping or ductwork.

.17 Provide and install accelerators or exhausters on the dry pipe valve stations to ensure water flow to each system at most remote location within 60 seconds.

.18 At each capped-off wet sprinkler location shown on the plans provide and install two bolted flanges with threaded female connection. Behind each cap-off there shall be installed a metal Blank and full gaskets punched for bolt holes. The metal Blank shall have a tab with 6 mm hole in tab for wire hanger connection. The metal Blank shall be fitted between the two bolted flanges and gaskets and made watertight. Bolted flanges shall be installed clear of ducts and other equipment.

.19 A wrap around hanger or other approved means shall be provided at the end of each branch sprinkler line to prevent excessive movement.

.20 Drop in inserts are not permitted. Use wedge type anchors or those indicated in Section 15090.

.21 The built in vertical adjustment on sprinkler heads shall not be used so that all nipples are the same length and the piping grade is achieved by having various non uniform sprinkler head depths with respect to the escutcheons. All heads and cups shall be uniform in depth and elevation.

.22 *See Bulletin 93-1 Protection of Standpipes and Sprinkler Piping Against Freezing in City of Vancouver design.

.23 Do not install any sprinkler heads until all piping systems have been flushed of all contaminants such as cutting oil.

.24 Provide wire guards on all sprinkler heads subject to damage, i.e. closets, mechanical rooms, equipment rooms, etc.

.25 Provide dry pendant or sidewall heads on all wet sprinkler systems with heads piped into cold areas.

.26 Provide sprinkler heads in all elevator pits and at top of elevator shafts.

.27 Provide breakaway sprinkler heads in all areas subject to damage such as security areas, prisons and psychiatric cells.

.28 All off site prefabrication of sprinkler piping shall be at the contractor’s own risk.

3.2 Testing

.1 All tests required by this standard for the work shall be performed by this Contractor. When the authority having jurisdiction desires to be present during the conduct of tests, the Contractor shall give the authority having jurisdiction advance notification of time tests to be performed.

.2 When the representative of authority having jurisdiction is not available and permission is granted by that authority, tests may be witnessed by the Owner or his representative and the Contractor's material and test certificate as per NFPA standards shall be completed and forwarded to the authority having jurisdiction.

.3 The sprinkler system is subject to final inspection test, and approval by the Fire Marshall and Consultant.

.4 Before requesting approval and acceptance testing of the equipment by the Fire Marshall, the installing company shall furnish a written statement to the effect that the work covered in this installation has been completed and tested in accordance with the approved plans and specifications, and shall provide a "Contractor's Material and Test Certificate" as required by the NFPA Standard No. 13, General Information.

.5 All systems and piping shall be tested hydrostatically at not less than 1380 kPa pressure for two (2) hours, or at 345 kPa in excess of the maximum static pressure when the maximum static pressure is in excess of 1034 kPa.

.6 The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.

.7 The inside piping shall be installed in such a manner that there will be no visible leakage when the system is subjected to the hydrostatic pressure test.

.8 Provide flushing connections on all sprinkler systems.

.9 Piping between the check valve in the fire department inlet pipe and the outside connection shall be tested the same as the balance of the system.

.10 Brine or other corrosive chemicals shall not be used for testing systems.

.11 *The Contractor shall retain the services of a required independent testing agency (approved by the Local Municipality) to carry out or witness flow verification tests for residential sprinkler systems in one and two family dwellings and residential buildings up to four stories in height. The agency shall forward all necessary documentation to the Plumbing Inspection Department to be recorded on the plumbing permit.

.12 No substance to stop leaks shall be introduced to any sprinkler system.

3.3 Final Approval

.1 Before asking final approval of the automatic dry and wet sprinkler system by the authority having jurisdiction, the installing company shall furnish a written statement to the effect that the work covered by its contract has been completed and tested in accordance with the approved specifications and plans.

.2 Contractor's Certificate - NFPA Testing Contractor's Certificate is to be completed and forwarded to the authority having jurisdiction and the Consultant as evidence that the necessary tests and materials have been provided. It is stressed that all sections of the certificate are to be completed.

.3 There shall be maintained on the premises a supply of spare sprinklers (never less that six (6)). These sprinklers shall correspond as to types and temperature ratings with the sprinklers in the property. The sprinklers shall be kept in a cabinet. The cabinet shall be located in the mechanical room.

.4 A special sprinkler wrench shall also be provided and kept in the cabinet, to be used in the removal and installation of sprinklers.

.5 The stock of spare sprinklers shall be as follows for each type of sprinkler head used on the project:

.1 For systems not over 300 sprinklers, not less than six (6) sprinklers.

.2 For systems 300 to 1,000 sprinklers, not less than twelve (12) sprinklers.

.3 For systems above 1,000 sprinklers, not less than twenty-four (24) sprinklers.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Fire extinguishers.

.2 Fire extinguisher cabinets and mounting hardware

1.2 General Requirements

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

1.3 Quality Assurance

.1 Fire protection equipment and installation shall be approved by local Fire Commissioner.

.2 Equipment and installation shall meet the requirements of NFPA No. 10 Portable Fire Extinguishers. – latest edition

1.4 Submittals

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

2. PRODUCTS

2.1 Portable Hand Fire Extinguishers

.1 Multi-Purpose Dry Chemical (Type 1): Pressurized with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets 4.5 kg 10 lb. capacity rating 4A:60BC; 9.0 kg 20 lb. capacity rating 10A:80BC.

.2 Water Pump Tank (Type 2): 11 L 3 US. gal. capacity *copper *stainless steel *galvanized steel *polyethylene plastic construction with mounting brackets. Rating 2A.

.3 Carbon Dioxide (Type 3): Hose and horn discharge, self-closing lever or squeeze grip operated, insulated handle fully charge and complete with mounting brackets, 2.25 kg 5 lb capacity. Rating 5BC.

.4 Potasium Bicarbonate Powder (Type 4): Pressurized with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets (9.0 kg 20 lb capacity). Rating 80BC.

2.2 Fire Extinguisher Cabinets and Brackets.

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

3. EXECUTION

3.1 Installation

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

3.2 Schedules

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

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

END OF SECTION

1. GENERAL

1.1 Scope

.1 Centrifugal fans.

.2 In-line duct fans.

.3 Fan accessories.

.4 Roof curbs.

1.2 Quality Assurance

.1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.

.2 Fans shall bear CSA label.

.3 Motors to be high efficiency as specified in Section 15010.

1.3 Submittals

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

1.4 Job Conditions

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

1.5 Alternates

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

2. PRODUCTS

2.1 Approved Manufacturers

.1 Fans – Centrifugal: Buffalo, Twin City, Trane, Chicago, Barry Flower, Norther.

.2 Fans – In-Line Cetrifugal:Greenheck, Jenn Air, Ammerman, ILG, Cook, Penn, Twin City, Carnes.

.3 Fans – In-Line Centrifugal (Tubular):Chicago, Greenheck, Twin City, Barry/CML, Northern Blower.

2.2 General

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Provide balanced variable sheaves for motors 11.2 kW (15 HP) and under and fixed sheave for 15 kW (20 HP) and over.

.3 Fans are to be capable of accommodating static pressure variations of +10% with no objectionable operating characteristics.

.4 Fan suppliers to provide replacement sheaves for balancing purposes.

.5 Provide cross linkage and inlet vanes on double inlet fan.

.6 Size motors for parallel operating fans for non-overloading operation with only one fan operating.

.7 Provide belt guards with tachometer holes.

.8 Exhaust fans for the commercial kitchen exhaust must be listed by ULC or ULI as a "Power Ventilator for Restaurant Exhaust Systems", and meet current NFPA-96 requirements.

.9 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for fan.

.10 Two speed motors shall have separate winding for each speed. Variable speed applications: Small (≥1/3 HP) shall be ???? duty c/w variable speed drive matched to fan motor.

2.3 Centrifugal Fans

.1 Fabricate with multi-blade wheels in heavy gauge steel housing reinforced for service encountered.

.2 Provide V-belt drives with fan and motor mounted on reinforced, rigid steel base with adjustable motor mount.

.3 Provide heavy duty, self-aligning, anti-friction bearings. Extend lubrication fittings to outside of fan casing.

.4 Provide where indicated variable inlet vanes complete with linkage and pneumatic operators.

.5 Provide access door and drain connection to scroll.

.6 Unless noted otherwise, centrifugal fans over 425 mm (17 in.) diameter shall have die formed air foil blades welded to side and back plate.

.7 Provide fan cabinets lined with minimum 25 mm (1 in.) acoustic insulation, unless noted otherwise elsewhere in the specifications.

3. EXECUTION

3.1 Installation

.1 Where inlet or outlet is exposed, provide safety screen.

.2 Provide belt guards on belt driven fans complete with tachometer access.

.3 Supply and install sheaves as necessary for final air balancing.

.4 Set roof mounted fans on curbs 200 mm (8 in.) minimum above roof. Provide acoustic insulation on duct to below roof line and on fan inlet plenum and drip pan for collecting condensation with drain line to nearest drain.

.5 Provide 100 mm (4 in.) high housekeeping base for floor mounted units.

3.2 Priming

.1 Prime coat fan wheels and housing at factory inside and outside. Prime coating on aluminum part is not required.

.2 Provide two additional coats of paint on fans handling air downstream of humidifiers.

3.3 Performance

.1 Fan performance based on *sea level *_____ m (ft) conditions.

.2 Refer to Equipment Schedule.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Access doors.

.2 Fire dampers.

.3 Fire stop flaps.

.4 Balancing dampers.

.5 Flexible connections.

.6 Backdraft dampers.

1.2 Quality Assurance

.1 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 “Fire Dampers”.

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.

.3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner’s representative.

.4 Access doors shall be ULC labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

.6 Prove all dampers to inspector at job completion.

1.3 Submittals

.1 Submit shop drawings of factory fabricated assemblies.

2. PRODUCTS

2.1 Acceptable Manufactures

.1 Backdraft Dampers: Airolite, Vent-Aire, Penn, T.A. Morrison.

.2 Balancing Dampers: Maxam, Ruskin.

.3 Control & Backdraft Dampers: Ruskin, Tamco.

.4 Smoke-Fire Combination Dampers: Ruskin, Controlled Air, Prefco.

.5 Dust Collectors: Murphy.

.6 Fire Dampers: Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor.

.7 Vent Caps: Jenn-Air, Penn Ventilator.

.8 Vent Sets: Greenheck, Trane, Sheldons, Buggalo, New York, Brundage, Loren Cook, Lau.

.9 Silencers: Vibro Acoustics, Vibron, Korfund, I.A.C., Koopers.

2.2 Duct Access Doors

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

.2 Fabricated with two butt hinges and two sash locks for sizes up to *450 mm* ***(18 in.),*** two hinges and two compression latches with outside and inside handles for sizes up to *600 mm x 12 00 mm* ***(24 in. x 48 in.)*** and an additional hinge for larger sizes.

2.3 Fire Dampers

.1 Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible ink.

.2 Fire dampers shall be curtain type with damper blades retained out of air stream in a recess so free area of connecting ductwork is not reduced.

.3 Fusible links shall be set for *71°C* ***(160°F.)***.

2.4 Fire Stop Flaps.

.1 Fabricate of heat retardant fabric in galvanized or prime coated black steel frame, spring loaded action to close and lock in closed position when released by fusible link.

.2 Blanket shall be retained in a recess so free area of connecting ductwork is not reduced.

.3 Fusible links shall be set for *71°C* ***(160°F.)***.

2.5 Balancing Dampers

.1 Fabricate of galvanized steel, minimum *1.6 mm* ***(16 ga.)*** Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length.

.2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to *400 mm* ***(16 in.)*** deep and on accessible round ducts.

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts *425 mm* ***(17 in.)*** and over in depth and on all inaccessible rectangular and round ducts.

.4 On rectangular ducts up to *275 mm* ***(11 in.)*** deep construct of single blade (butterfly) type.

.5 On rectangular ducts *300 mm to 400 mm* ***(12 in. to 16 in.)*** deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.6 On rectangular ducts over *425 mm* ***(17 in.)*** deep construct of multiple opposed blades mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.

.7 On round ducts construct of single blade (butterfly) type. On *500 pascal* ***(2 in.wg.)*** class and on all dampers over *300 mm* ***(12 in.)*** diameter fabricate with full blade-length shaft.

.8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.

.9 Provide over-ride limiting stops on all operating mechanisms.

.10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.

.11 On round ductwork install operating mechanism on a steel mounted base firmly secured to the ductwork.

.12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.6 Flexible Connections

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately *150 mm **(6 in.)*** wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at *150 mm **(6 in.)*** intervals. Flexible connection airtight at *500 Pa **(2 in.wg.)**.*

.2 Do not use flexible connections to connect kitchen ductwork to kitchen fans where the fan is mounted inside the building enclosure. Fan connections in these cases shall be governed by NFPA 96 (flanged connections).

2.7 Backdraft Dampers

.1 Construct of minimum *1.3 mm **(18 ga.)*** aluminum channel frame.

.2 Construct of minimum *0.6 mm **(24 ga.)*** aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to *240 mm **(9.5 in.)***, multiblade dampers for ducts greater than *240 mm **(9.5 in.)***.

.3 Provide full blade-length shafts complete with brass or nylon bearings.

.4 Provide neoprene anti-clatter blade strips on pivot side of blades.

.5 Construct blade connecting linkage of minimum *2.0 mm **(12 ga.)*** aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.6 Maximum blade length of 750 *mm **(30 in.)**.*

.7 Backdraft damper suitable for 10 *m/s **(2000 fpm)*** face velocity.

3. EXECUTION

3.1 Application

.1 Provide access door minimum *450 mm x 350 mm **(18 in. x 14 in.)*** or *50 mm **(2 in.)*** smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 Both sides of turning vanes in all ducts.

.2 At each fire damper location.

.3 At each side of all heating or cooling coils.

.4 At all locations of internally duct mounted devices including automatic dampers, damper motors and control sensors and devices.

.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.3 At each point where ducts pass through duct shall be sealed with non-combustible material.

.4 Provide balancing dampers at points on supply and exhaust systems where branches are taken from larger ducts as required for proper air balancing.

.5 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

.6 All fire dampers and fire stop flaps are to be left in the closed position for balancing contractor to fix open.

.7 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

END OF SECTION

1. GENERAL

1.1 Scope

.1 When the duct systems are completed and before any fan systems are operated, all ductwork, plenums, coils and air handling equipment shall be cleaned by compressed air and mechanical equipment; or compressed air and high power suction equipment. No special cleaning is required for exhaust ductwork systems that convey air directly to the outside at all times without recirculation.

.2 Clean all new and existing ductwork.

.3 A letter shall be submitted by the cleaning company certifying that all systems have been completely cleaned.

1.2 Quality Assurance

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

2. PRODUCTS

2.1 Materials

.1 The sheet metal subtrade shall provide all necessary access doors to facilitate efficient ductwork cleaning as listed under installation.

.2 Provide approved filters to protect equipment during cleaning operation. Submit shop drawings indicating which type of filters are to be utilized to protect equipment during construction and cleaning operation.

.3 The contractor shall sample and analyze the contamination in the ductwork as requested by the Engineer. The results may be verified by an independent laboratory, paid for by the Contractor, specializing in this type of work.

3. EXECUTION

3.1 Installation

.1 Ductwork access doors for ductwork cleaning shall be installed as follows:

.1 At *10 m**33 ft.*** intervals in all duct systems.

.2 At the base of all duct risers.

.3 Both sides of turning vanes in all ducts.

.4 At each fire damper location.

.5 At each side of all heating or cooling coils.

.6 At all locations of internally duct mounted equipment or devices including balancing dampers, automatic dampers, damper motors and controls.

.2 Access doors shall be as specified in Section 15860, "Duct Accessories". Access panels with screws are not acceptable.

.3 Access door size shall be a minimum *450 mm**18 in.*** x *350 mm**14 in.*** or *50 mm**2 in.*** smaller than duct dimension.

.4 For duct cleaning system utilizing compressed air and mechanical brush, suitably sized access points with positive locking cover shall be installed at *3 m**10 ft.* interval in the duct work and on both sides of dampers, coils, turning vanes, etc.

.5 Access system shall be reusable to allow for future inspection or cleaning.

.6 All ductwork outlets shall b sealed with suitable cover after ductwork has been cleaned. All plenums to be sealed after plenums have been cleaned.

.7 Prior to any work being started on the system, filter media shall be installed behind every supply grille or diffuser. This will act as a safety net for contamination which may be disturbed during cleaning. After a settling down period of two to five days, the filter media will be removed.

.8 Each aspect of the system shall be cleaned regardless of the size, type or configuration. Dirt clinging to the sides or top of ducting must be removed and left as clean as the bottom. Spiral ducting should be as clean as flat.

.9 After completion of cleaning and approval by the owner's representative, the complete system shall be disinfected with a chemical directly applied to the ductwork. The chemical shall be applied using compressed air and spray wand that emits a 360° spray pattern. Mist or fog applications will not be allowed. Chemical to be used is JOHNSON ENDBAC 128, or approved equal.

.10 A monitoring probe should be fitted to each system as part of the warranty program. Visible monitoring will enable the owner to easily and accurately watch future build-up of contamination.

3.2 Inspection

.1 The cleanliness of ductwork shall be inspected using a borescope supplied by the contractor. This shall be made available to the owner at all times.

.2 Any ductwork found to be dirty shall be redone through its entire length at no extra cost to the Owner.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Diffusers.

.2 Grilles and registers.

.3 Outside louvres.

.4 Door grilles.

.5 Diffuser boots.

.6 Roof hoods.

.7 Goosenecks.

1.2 Quality Assurance

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.

.2 Unit rating shall be approved by ADC and AMCA.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

.4 Outside louvres shall bear AMCA seal for free area and water penetration.

1.3 Project Conditions

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.

.2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform with Architectural features, symmetry and lighting arrangement.

1.4 Submittals

.1 Submit shop drawings with complete catalogue information, materials of construction, dimensions and accessories.

.2 Submit colour selection charts of finishes for approval prior to fabrication.

2. PRODUCTS

2.1 Approved Manufactures

.1 Air Terminals – Grilles, Registers, Diffusers: E.H. Price, Titus, Amenostat, Nailor.

.2 Louvres: Airolite, Penn, Airstream, West Vent, Nailor, Ruskin.

2.2 General

.1 Base air outlet application on space noise level of NC 30 maximum.

.2 Provide supply outlets with sponge rubber seal around the edge.

.3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.4 Provide plaster frame for diffusers located in plaster surfaces.

.5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.6 Provide 30 mm margin frame with (countersunk screw holes) (concealed fastening).

.7 *Fabricate of (steel with 1.0 mm minimum frames and 0.8 mm minimum blade),(steel and aluminum with 1.0 mm minimum frame), (or heavy aluminum extrusions).

.8 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.9 In gymnasium, Aquatic Centres, front blades shall be front pivoted, welded in place or securely fastened to be immobile.

.10 *Finish in factory (baked enamel) (prime coat) finish.

.11 Refer to Air Outlet Schedule for specifications of air outlets.

2.3 Door Grilles

.1 Fabricate of V-shaped louvres of 1.0 mm (20 ga.) steel, 25 mm (1 in.) deep on 15 mm (1/2 in.) centres.

.2 Provide 1.0 mm (20 ga.) steel frame with auxiliary frame to give finished appearance on both sides of door.

.3 Factory finish in prime coating.

2.4 Outside Louvres

.1 Louvres *100 mm (4 in.) *150 mm (6 in.) deep with blades on 45° slope *with centre baffle and return bend heavy channel frame, birdscreen with 15 mm (1/2 in.) square mesh.

.2 *Fabricate of 1.6 mm (16 ga.) galvanized steel blades and frame. Provide welded assembly.
*Fabricate of *2.0 mm* ***(14 ga.)*** extruded aluminum blades and frame. Where openings exceed *1800 mm* ***(72 in.)*** in height, jamb frames shall be *2.0 mm* ***(14 ga.)*** Provide welded assembly.

.3 Finish in factory *prime coat *baked enamel *anodized finish. Colour shall be selected by the Architect.

.4 Fabricate louvred penthouses with mitered corners and sheet roof reinforced with structural angles.

2.5 Roof Hoods

.1 Air inlet or exhaust hoods shall have removable hood, curb flange and birdscreen with 15 mm (1/2 in.) square mesh.

.2 Fabricate of *galvanized steel minimum 1.6 mm (16 ga.) base and 1.0 mm (20 ga.) hood or *aluminum 1.6 mm (16 ga.) base and 1.3 mm (18 ga.) hood. Provide suitable reinforcing to hood. Louvres shall be storm proof.

.3 Mount unit on minimum 300 mm (12 in.) high curb base with insulation between duct and curb.

.4 Finish in factory *prime coat *baked enamel *anodized finish.

.5 Hood outlet area shall be minimum twice throat area.

2.6 Goosenecks

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

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

3. EXECUTION

3.1 Priming

.1 Paint ductwork visible behind air outlets matte black.

3.2 Sizing

.1 Size outside air louvres as indicated on drawings.

.2 Size air outlets as indicated on drawings.

3.3 Seismic Requirements

.1 All air outlets mounted in a t'bar ceiling shall be seismically restrained by:

.1 Secure attachment to solid ductwork which is braced at the outlet.

.2 Wire hangers attached to structure. Minimum of two (2) per outlet and one per 1200 mm length.

.2 Air outlets other than t'bar mounting must be securely attached to the building elements.

3.4 Air Outlets Schedule

.1 Refer to Equipment Schedules.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Panel filters.

.2 Cube filters.

.3 Pleated filters.

.4 High efficiency bag filters.

.5 Roll filters.

.6 Electronic air filters.

.7 Hepa filters.

1.2 Quality Assurance

.1 Filters shall be product of and supplied by one manufacturer.

.2 Filter media shall be UL listed, Class I or Class II.

.3 Filter components assembled to form filter banks shall be products of same manufacturer.

.4 All filters except HEPA shall be in accordance with ASHRAE Standard 52.76.

.5 Filters containing asbestos, urea formaldehyde or fibreglass shall not be acceptable.

1.3 Alternatives

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

2. PRODUCTS

2.1 Frames

.1 Fabricate filter frames and supporting structures of galvanized steel or extruded aluminum with necessary gasketing between frames and walls. Provide holding frames *1.6 mm,**16 gauge,*** "T" section construction.

.2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

2.2 Panel Filters

.1 Media: The air filter shall consist of a 3 ply panel filter element in a uniform non woven structure. The filter shall be fabricated from variable denier Dacron fibres offering a graduated media with minimum loft of *40 mm**1 1/2 in.*** and shall be progressively bonded with a fire retardant latex binder.

.2 The filter shall contain a non migrating tackifier impregnated between the second and third ply to prevent unloading of the tackifier downstream.

.3 Holding Frames: *1.3 mm**18 gauge*** minimum galvanized frame with expanded metal grid on leaving air side and steel rod grid on air entering side, hinged with pull and retaining handles.

.4 The filter shall be Class II listed by UL.

.5 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

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

2.3 Cube Filters

.1 Media: The air filter shall consist of a 3 ply filter element in a uniform non woven weave structure.

.2 The filter shall be fabricated from variable denier Dacron fibres offering a graduated media with a minimum loft of *25 mm**1 in.*** and shall be progressively bonded with a fire retardant latex binder.

.3 The filter shall be welded around an internal wire header that requires no additional hardware to install in the frame. The filter shall contain non migrating tackifier impregnated between 2nd and 3rd plys to prevent unloading of tackifier downstream.

.4 The filter shall have an efficiency of 45% based on ASHRAE 52-76 at *2.03 m/s**400 fpm*** maximum face velocity.

.5 The filter shall be Class II listed by UL.

.6 Filters containing asbestos, urea formaldehyde, or fibreglass will not be accepted.

2.4 Pleated Filters

.1 Media: The filter shall be constructed of non-woven reinforced cotton rayon. A diamond grid with 98% open area shall provide support for the media. The media shall be bonded to media support to ensure pleat stability. A rigid, moisture resistance heavy duty kraft board shall enclose the media. The filter pack shall be bonded to the inside periphery of the frame to eliminate air bypass.

.2 The efficiency shall be (30-35%) (50-55%) based on ASHRAE 52-76 up to *2.54 m/s**500 fpm*** for *25 mm**1 in.*** and *50 mm**2 in.*** thick and up to *3.05 m/s**600 fpm*** for *100 mm**4 in.*** thick.

.3 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

2.5 High Efficiency Bag Filters

.1 Media: The filter shall consist of 3 layers of progressively structured filter media combining synthetic unbreakable micro wires with prefilter media layer. Packets are to be self supported, leak free welded and an integral part of the header frame which shall be made of corrosion resistant hard polyurethane foam constructed to withstand up to 100% relative humidity, high velocity and turbulence.

.2 The filter shall have an efficiency of 90% based on ASHRAE 52-76 at a face velocity of *2.54 m/s**500 fpm*** maximum and an initial resistance of *105 Pa.**0.4 in.w.g.***

.3 The filter shall be Class II listed by UL.

.4 No filter containing asbestos, urea formaldehyde or fibreglass will be accepted.

.5 Holding Frames: *1.6 mm**16 gauge*** galvanized steel with sealing grooves and gaskets, locking clips and provision for (front mounted) panel prefilter and (front) (rear) removal of filter media.

2.6 Roll Filters

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

.2 Media: Rolled and compressed non breakable, no shredding polyester fibres available on one or two ply with scrim backing. Efficiency shall be (15%) (25%) based on N.B.S. atmosphere test.

.3 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

.4 Drive Mechanism: (Electric gear reducer motor) (Hand crank for manual operation) to wind rewind spool through chain and sprocket.

.5 Controls: Provide manual switch to advance media.

2.7 Electronic Air Cleaners

.1 General Assembly: Heavy gauge galvanized steel assembly containing electronic agglomerator and (panel) (roll) (high efficiency) bag filters.

.2 Electronic Agglomerator: Independently supported and nested collection cells of aluminum construction including ionizing wires, grounded struts, positive and negative plates, insulators, ionizer and plate contacts. Locate insulators out of air stream.

.3 Power Pack: Self-contained, pre-wired rectifying unit to convert 115V AC to approximately 1200 V DC for ionizer and 6000 V DC for collector, including overload protection, on-off switch, pilot light indicating operating status and safety accessories.

.4 Safety Accessories: For filter plenum access doors, provide manual reset safety switches and warning lights and enameled high voltage warning signs. Provide signal lights and safety switching upstream and downstream of unit within duct.

.5 Efficiency: Media efficiency minimum (85%) (90%) (95%) NBS (atmospheric) type tests.

2.8 HEPA Filters

.1 The filter shall be constructed of fire retardant water proof glass paper folded sheets with string separators to ensure constant spacing of the folds. Folds are sealed in the frame by means of (mineral seal, PVC or silicon).

.2 The frame shall be (galvanized/stainless steel).

.3 Gaskets shall be half round *10 mm**0.4 in.*** (neoprene foam/silicon) moulded in one piece.

.4 The filters shall be individually tested and certified to have an efficiency of not less than (95%/99.97%/99.9%) when tested with 0.3 micro dioctylphthalate smoke. The initial pressure drop will not exceed *250 Pa**1 in.w.g.*** when operating at a velocity of *2.54 m/s.**500 fpm.***

.5 The filter shall be Class II listed by UL.

.6 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

3. EXECUTION

3.1 Installation

.1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.

.2 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at take-over by the Owner. Replace filters used during construction.

.3 Provide filter banks in arrangement shown with removal and access indicated.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Dry steam humidifier with distribution manifold.

.2 Controls connections.

.3 Steam and condensate connections.

.4 Duct mounting.

1.2 Quality Assurance

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

1.3 General Requirements

.1 Factory assemble units prior to shipment.

1.4 Submittals

.1 Submit shop drawings for review.

2. PRODUCTS

2.1 Approved Manufacturers

.1 Humidifiers – Electric

.1 Armstrong, Vapac, Nortec, Dri-Steam.

.2 Humidifiers – Steam

.1 Armstrong, Sarco, Dri-Steam.

2.2 General

.1 Humidifiers shall be suitable for (pneumatic) (electric) (electronic) modulating control.

.2 Humidifier shall be steam separator type providing full separation ahead of integral steam jacketed control valve which discharge through internal steam jacketed drying and silencing chambers and a steam jacketed distribution manifold.

.3 Humidifier shall receive steam at supply pressure and discharge at atmospheric pressure.

2.3 Steam Separator

.1 Separating chamber shall disengage and remove water droplets and particulate matter larger than 3 microns when humidifier is operating at maximum capacity.

.2 Integral metering valve shall be steam jacketed parabolic plug, capable of modulating flow of steam over entire stroke of operator.

.3 Internal drying and silencing chamber shall receive steam at atmospheric pressure and be jacketed by steam at supply pressure. Silencing chamber shall utilize stainless steel silencing medium.

2.4 Distribution Manifold

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

2.5 Controls

.1 Supply units with integral (pneumatic) (electric) (electronic) operator.

.2 Equip with interlocked temperature switch to prevent humidifier from operating before start-up condensate is drained.

3. EXECUTION

3.1 Installation

.1 Furnish with inlet strainers and external inverted bucket steam trap.

.2 Provide galvanized steel rods to support distribution manifolds in air plenums.

.3 In-duct humidifiers shall be installed in a min. 60” (1.5m) long section of stainless steel duct with the bottom section sloped at 5% down to a drain point below the humidifier distributor bar.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

Note: Contractor to provide separate price for Controls scope of work.

1. GENERAL

1.1 General

.1 The project will achieve or exceed following temperature, humidity and acoustical requirements:

.2 Commissioning and stabilization of HVAC function in museums: Environment standards for a Class A museum tolerate only a minimal variation of temperature and humidity over the course of 24 hours. Proof of stability is a requirement using these charts, by lenders such as the National Gallery of Canada for approval of artwork loans to the Surrey Art Gallery: Requirements for proving consistency are the paper hygrothermograph charts sourced from a number of machines placed throughout the Gallery's art handling/storage, exhibition and preparation spaces at the height of art storage and display.

.3 Temperature: should be set at a steady temperature within this range 18-24ºC and controlled with a variation no more than ±1ºC over 24 hours. The Gallery recommends 20C.

.4 Relative Humidity: 40-55% and should be set within this range and not vary more than the control value variation of ± 5% over 24 hours. The Gallery recommends 50%.

.5 New HVAC units meet CCI requirements for a Class A museum - Fluctuations must be within minimal tolerances over limited passages of time

.6 HVAC units operate to museum standard until scheduled removal - No fluctuations can occur while artwork is on display or in gallery art holding or prep areas

.7 HVAC units and air systems need to be very quiet as the Gallery presents audio art. - The HVAC needs to be almost silent

1.2 Summary

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS).

.2 Control devices integral to the low voltage control panel and emergency stop buttons.

1.3 References

.1 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250-[03], Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 Canadian Standards Association (CSA International).

.1 CSA-C22.1-[02], Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.4 Definitions

.1 Acronyms and Definitions: refer to General Requirements.

1.5 Submittals

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

2. PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, assembly.

.3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, and pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 Temperature Sensors

.1 General: contractor shall provide standard 10k ohm type-3 thermistor temperature sensors. Room sensors and displays to be Delta DNS-24L LCD display.

.1 Thermocouples: limit to temperature range of 200 degrees C and over.

.2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length as indicated.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module. (All Spaces except Area)

.1 LCD display to show space temperature, temperature setpoint, occupied/unoccupied mode, Unit status.

.2 Buttons for occupant selection of temperature setpoint.

.3 Motion sensor for Occupied / Unoccupied mode.

.4 Integral thermistor sensing element 10,000 ohm at 24 degrees.

.5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.

.6 Stability 0.02 degrees C drift per year.

.7 Separate mounting base for ease of installation.

.8 Wall mounting, in slotted type covers with lockable guard.

.9 Able to provide a dead band of at least 5°F within of which the supply of heating and cooling energy to the space is reduced to a minimum.

.2 Room temperature sensors. (Space)

.1 Wall mounting, in slotted type covers having brushed aluminum finish, with lockable guard.

.2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.

.3 Duct temperature sensors:

.1 General purpose duct type: suitable for insertion into ducts at various orientations.

.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.4 Outdoor air temperature sensors:

.1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 Temperature Transmitters

.1 Requirements:

.1 Temperature transmitters not required where thermistors are used.

.2 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.3 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

.4 Output signal: 4 - 20 mA into [500 ohm maximum load.

.5 Input and output short circuit and open circuit protection.

.6 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.

.7 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.

.8 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.9 Integral zero and span adjustments.

.10 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.

.11 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.

.12 Transmitter ranges: select narrowest range to suit application from following:

.1 Minus 20 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

2.4 Humidity Sensors

.1 Room and Duct Requirements:

.1 Range: 5 - 90 % RH minimum.

.2 Operating temperature range: 0 - 60 degrees C.

.3 Absolute accuracy:

.1 Duct sensors: plus or minus 3 %.

.2 Room sensors: plus or minus 1 %.

.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.

.5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.

.6 Room sensors: wall mounted as indicated. Provide in slotted type covers having brushed aluminum finish, with lockable guard.

.7 Duct mounted sensors: locate so that sensing element is in air flow in duct.

.2 Outdoor Humidity Requirements:

.1 Range: 0 - 100 % RH minimum.

.2 Operating temperature range: -40 - 50 degrees C.

.3 Absolute accuracy: plus or minus 2 %.

.4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.

.5 Must be unaffected by condensation or 100% saturation.

.6 No routine maintenance or calibration is required.

2.5 Humidity Transmitters

.1 Requirements:

.1 Input signal: from RH sensor.

.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.

.3 Input and output short circuit and open circuit protection.

.4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.

.5 Output linearity error: plus or minus 1.0% maximum of full scale output.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.

.8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.6 Pressure Transducers

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.6 Over-pressure input protection to at least twice rated input pressure.

.7 Output short circuit and open circuit protection.

.8 Accuracy: plus or minus 1% of Full Scale.

2.7 Static Pressure Sensors

.1 Requirements:

.1 Multipoint element with self-averaging manifold.

.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).

.2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.8 Static Pressure Transmitters

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.

.3 Accuracy: 0.4 % of span.

.4 Repeatability: within 0.5 % of output.

.5 Linearity: within 1.5 % of span.

.6 Deadband or hysteresis: 0.1% of span.

.7 External exposed zero and span adjustment.

.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.9 Pressure and Differential Pressure Switches

.1 Requirements:

.1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.

.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2 % repetitive switching.

.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.10 Temperature Switches

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 Degrees C.

.4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Duct, general purpose: insertion length = 460 mm.

.2 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.3 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.4 Strap-on: with helical screw stainless steel clamp.

2.11 Air Pressure Gauges

.1 Diameter: 38 mm minimum.

.2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

2.12 Electromechanical Relays

.1 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 24V DC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120V AC.

.4 Relay to have visual status indication

2.13 Solid State Relays

.1 General:

.1 Relays to be socket or rail mounted.

.2 Relays to have LED Indicator

.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.

.4 Operating temperature range to be -20 degrees C to 70 degrees C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.

.7 Operational frequency range, 45 to 65 HZ.

.2 Input:

.1 Control voltage, 3 to 32 VDC.

.2 Drop out voltage, 1.2 VDC.

.3 Maximum input current to match AO (Analog Output) board.

.3 Output.

.1 AC or DC Output Model to suit application.

2.14 Current Transducers

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.15 Current Sensing Relays

.1 Requirements:

.1 Suitable to detect belt loss or motor failure.

.2 Trip point adjustment, output status LED.

.3 Split core for easy mounting.

.4 Induced sensor power.

.5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.

.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.

.7 Adjustable latch level.

2.16 Control Dampers

.1 Construction: blades, 152 mm wide, 1500 mm long, maximum. Modular maximum size, 1500 mm wide x 1500 mm high. Three or more sections to be operated by jack shafts.

.2 Materials:

.1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.

.2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.

.3 Bearings: maintenance free, synthetic type of material.

.4 Linkage and shafts: aluminum.

.5 Seals: synthetic type, mechanically locked into blade edges.

.1 Frame seals: synthetic type, mechanically locked into frame sides.

.3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.

.1 Size/Capacity: refer to damper schedule

.2 25 L/s/m^2 maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.

.3 Temperature range: minus 40 degrees C to plus 100 degrees C.

.4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.

.5 Jack shafts:

.1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.

.2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.

.3 Install using manufacturers installation guidelines.

.4 Use same manufacturer as damper sections.

2.17 Electronic Control Damper Actuators

.1 Requirements:

.1 Direct mount proportional type as indicated.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.

.4 Power requirements: 5 VA maximum at 24 V AC.

.5 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.18 Control Valves

.1 Body: globe style.

.1 Flow characteristic per equipment being served.

.2 Flow factor (KV): CV in imperial units.

.3 Normally open or Normally closed, as indicated in control sequences.

.4 Two or Three port, as indicated on drawings.

.5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.6 Packing easily replaceable.

.7 Stem, stainless steel.

.8 Plug and seat, bronze.

.9 Disc, replaceable, material to suit application.

.10 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Rangeability 50:1 minimum.

.11 NPS 22 and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

2.19 Electronic / Electric Valve Actuators

.1 Requirements:

.1 Construction: aluminum.

.2 Control signal: 0-10V DC or 4-20 mA DC.

.3 Positioning time: to suit application. 90 sec maximum.

.4 Fail to normal position as indicated.

.5 Scale or dial indication of actual control valve position.

.6 Size actuator to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.8 Minimum shut-off pressure: refer to control valve schedule.

2.20 Wiring

.1 In accordance with Section 26 27 10 - Modular Wiring System and / or 26 27 26 - Wiring Devices.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:

.1 Field wiring to digital device: #20AWG stranded twisted pair.

.2 Analog input and output: shielded #20 minimum stranded twisted pair.

3. EXECUTION

3.1 Installation

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Duct static pressure sensors are to be placed in a location such that the controller set-point is no greater than one-third the total design fan static pressure.

.4 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.5 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.6 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.

.7 Electrical:

.1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.4 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 Temperature and Humidity Sensors

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.4 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

.2 Wire multiple sensors in series for low temperature protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use software averaging algorithm to derive overall average for control purposes.

.6 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.3 Panels

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 Pressure and Differential Pressure Switches and Sensors

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.5 I/P Transducers

.1 Install air pressure gauge on outlet.

3.6 Air Pressure Gauges

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.7 Identification

.1 Identify field devices in accordance with Section Identification.

4. GENERAL

4.1 Summary

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

.2 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.3 The relationships between the points, systems and building are described in the control sequences.

.4 Review with the Consultant during the shop drawing stage to finalize the control sequences for each system.

.5 The attached points list is a summary of EMCS points. They should be considered as an accurate estimate and not the final quantity. Should additional points be required as described in other sections within the EMCS specification then the contractor shall include the larger quantity.

5. EXECUTION

5.1 Data Archiving (SEPARATE PRICE)

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

.2 Provide Coppertree Cloud services for:

.1 Offsite Data Archiving of all Trend Logs

.1 The Coppercube will automatically push the archived data in its memory to the Coppertree cloud for backing up the archived data. This will be performed on a daily basis or more frequently depending on the dashboard requirement for data display (archived versus near real time).

.2 The Client will be able to retrieve this data at any time through the client portal web access to the Coppertree Cloud data.

.2 DDC System Integrity Analysis Reporting

.1 The Coppertree Cloud service shall provide the following system checks and provide a report to the Fortis designate desktop via email for the following:

.1 Analog/binary inputs in manual override

.2 Analog/binary outputs in manual override

.3 Analog/binary inputs in decommissioned mode

.4 Analog/binary outputs in decommissioned mode

.5 Firmware version check

.6 Firmware uniformity check

.7 Device time synchronization check

.8 Device low memory check

.9 Device system status check

.10 Schedule in manual override

.11 Calendar in manual override

.12 Control loop object in manual override

.13 Control loop object tuning (simple) check

.3 Benchmark Analysis Reporting

.1 Analog input calibration changed

.2 Analog input sensor type (scale-range) changed

.3 Binary input action changed

.4 Analog/binary output action changed

.5 Device reset count increased

.6 Weekly schedule modified

.7 Calendar modified

.8 GCL program modified

.9 Control loop object settings modified

.10 Trendlog settings modified

.11 Totalizer settings modified

.12 Event settings modified

.13 Device settings modified

.14 Network settings modified

.4 Automatic DDC System Database Backups

.1 The DDC System controller database will be automatically backed up to the Coppertree Cloud once per week.

.2 The Client will be able to retrieve this data at any time through the client portal web access to the Coppertree Cloud data.

.5 Historical Analysis Reporting

.1 Historical reporting to include:

.1 Input out-of-range check

.2 Control loop object tuning (complex) check

.3 Zone temperature control KPI reporting

.4 Control Loop KPI reporting

.6 Fault Detection Diagnostics Reporting Tool

.1 Provide Dataflow development tool to create fault detection diagnostics rules that will analyse and report based on the FDD rules required.

.7 Gold Standard Comparison Report

.1 Upon completion of the installation and after commissioning of the building, the Coppertree Analytics engine shall be set to take a snap shot of the entire DDC system parameters available to the building operators and/or service agents. Any change from these parameters will be reported by the Coppertree Analytics engine in a weekly report and prioritized by potential impact to energy or comfort.

.8 Energy Dashboard Display and Calculations (Note: dashboard hardware not in scope)

.1 The Coppertree Cloud service shall be able to provide public dashboard display of energy information based on:

.1 Historical archived data from metering that is connected to the DDC system

.2 Historical Archived data from virtual meters that are calculated from hardware status points that are connected to the DDC system (ie. VFD feedback for motor loads, magnetic starter operation, auxiliary contact from packaged equipment, BACnet information collection via integration from 3rd party systems, etc.)

.3 The Coppertree Cloud service engine shall provide the mathematics, normalization, Qsum analysis, and other features to allow the raw historical archived data to be analysed and displayed for meaningful viewing

.4 The system shall be capable of connecting to a (future) Dashboard display with the following potential displays at minimum:

.1 Graphical plots, pie charts , bar carts etc

.2 Base line analysis of actual against target.

.3 Historical analysis by year , month , week , day , hour or minute (dependent on the trend sample timing of the physical point)

.4 Current year performance displays as compared to previous year

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

5.2 General Requirements

.1 Provide the database for all physical points listed in the drawings, on the points list and as described in the control sequence.

.2 Provide the database for all virtual points identified in this section. Virtual points are shown in bold capitalized italic. Provide all necessary controllers, display screens, trend logs as well as any other item as may be required to create, test and modify the control strategies.

.3 Provide all programming required to implement the control sequences described in this section.

.4 Programming style is to be of a form that enables the control strategies to be easily followed. Clarity, simplicity and elegance are more important than program size.

.5 Programs shall be modular in nature and shall be as structured as the language will permit.

.6 All programs must include a sufficient number of comments to allow another person to make changes to the strategies at some later time.

.7 Additional programming may be provided by the Contractor as desired, so long as it does not affect the intended operation of the specified sequences. Ensure that all equipment will operate in a safe manner.

.8 Programming required for equipment safety may be installed by the Contractor as necessary. The Owner shall be notified of these changes as soon as practical.

.9 All deviations from the specified programming, except those related to equipment safety, must receive prior written approval from the Engineer.

.10 All control loops shall be tuned such that they are stable through all seasons and operating conditions including startup.

.11 All HVAC controls shall implement Building operating modes. Unit system description is modifications to the Building operation modes.

5.3 Miscellaneous Requirements

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

5.4 Global Programs

.1 Define a space temperature objective value STOBJ. Program it with a default value of 21 deg C such that the value returns to 21 if the point is not manually commanded to some other value.

.2 Define a space temperature objective user adjust value STOBJ_UA (limited – 0.5 to +0.5 deg C). Program it with a default value of zero deg C such that the value returns to zero if the point is not manually commanded to some other value.

.3 Obtain some basic information from the room temperature sensors:

.1 STMAX warmest space temperature.

.2 STAVG average of the four sensors.

.3 STMIN coolest space temperature

.4 Define an effective space temperature STEFF, for the building as follows:

.1 If the outside air temperature OAT is less than 5 deg C then STEFF is the average of STMIN and STAVG.

.2 If OAT is greater than 20 deg C then STEFF is the average of STMAX and STAVG.

.3 Otherwise STEFF equals STAVG.

.4 Smooth STEFF so that it cannot change faster than about 1 deg C per hour.

.5 Provide an outside air temperature prediction routine which provides the following data:

.1 OAPHT predicted high temperature.

.2 Oaplt predicted low temperature.

.3 Oadh day's high temperature.

.4 Oahdh hour that day's high occurred.

.5 Oadl day's low temperature.

.6 Oahdl hour that day's low occurred.

.7 Oaytd yesterday's temperature difference.

.8 Oaodh old (previous) day's high temperature.

.9 Oaodl old (previous) day's low temperature.

.6 Provide the following critical dial-out alarms:

.1 Low space temperature via STMIN < 12 degC.

5.5 Verification of Custom Control Software

.1 Provide copies of trend logs that clearly indicate the:

.1 stability of each control loop under various load conditions including modest step setpoint changes.

.2 adequacy of system startup during summer and winter conditions.

.3 proper operation of the outside air temperature prediction routines.

.4 adequacy of space comfort conditions.

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

END OF SECTION

ATTACHMENT #2

to

ADDENDUM #3

MECHANICAL ADDENDUM NO. 1

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

1. DRAWINGS – MECHANICAL

1.1 Drawing No.: M001

.1 Question: We also require the line size for the steam and condensate lines from the engineer?

.1 Clarification: Humidifier (electric) units shall have piping line sizes per manufacturer recommendation, noted per equipment schedule. Equipment cutsheets for specified units; with line sizes shown, are attached for reference.

1.2 Drawing No.: M002

.1 Revise: Contractor to note Air Conditioning Schedule has been revised. All new AHUs shall be provided as 575V (not 208V). Contractor to refer to attached, for revised Equipment Schedule & Motorlist.

.2 Questions: The new AHU's come with a shipped lose control panel. Who will be responsible for mounting of the panel? Who will be responsible for interconnecting wiring between the panel and the unit? Who will be responsible for interconnecting wiring between indoor and outdoor units?

.1 Clarification: Contractor to note new AHUs, as specified, C/W control panel, shipped w/ wiring completed (no field wiring required). AHU and control panel shall be provided w/ and connected by 6'0" water tight cable. Panel shall be installed by Mechanical Contractor, per manufacturer recommendation (within 6'0"). Controls Contractor shall be responsible for low voltage wiring between indoor and outdoor units, with installation per manufacturer recommendation. Refer to Equipment Schedule & Motorlist attached.

1.3 Drawing No.: M002, M201 & M303

.1 Revise: AHU-7 equipment selection currently specified as DX cooling c/w electric heating type, shall be revised to DX Cooling c/w hydronic heating type. Contractor to refer to attached, for revised AHU-7 Equipment Schedule and Schematic.

.2 Add: Contractor to note, existing HWS/HWR lines are currently located within Prep Area Room (by gridline 2 between gridlines R & V). Reuse of existing HWS/HWR lines to serve AHU-7 is mechanically acceptable, and requested by owner. Existing dedicated pump and trim to remain; contractor to modify existing connections as required to accommodate new AHU-7 and meet design intent. Commissioning, testing and balancing of all existing systems and equipment affected by this scope of work shall be included for by contractor and as part of close-out documentation.

1.4 Drawing No.: M102 & M201

.1 Add: Contractor to note mechanical scope of work area is currently fully sprinklered. Project scope of work will require relocations/additions of sprinkler heads to accommodate new equipment. Contractor to allow all required sprinkler work within their bid documents to provide fully sprinklered project work area, per NFPA-13. Sprinkler contractors engineer of record Inspection and Letter of Assurance (Schedule C-B) will be provided by contractor as part of close-out documentation.

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

1.5 Drawing No.: M103

.1 Add: Contractor to note, provide new Stainless Steel caps for the existing roof curbs. New caps shall cover the top of the existing roof curbs and extend downwards, so the existing roof membrane will be protected. New caps shall be 1 inch greater/wider than the top of the existing roof curbs and c/w 3 inches long skirts. Contractor to verify conditions on site and provide new caps as required to meet design intent.

.2 Questions: I have noticed that there will be 5 units on top of 4 existing roof curbs. We have made provisions to use HSS Structural Steel across all 4 curbs which will overhang about 6 ft on each end to accommodate all 5 units (as per mechanical drawings). Please confirm if that will be acceptable. Will there be any addition of new roof curbs?

.1 Clarification: Contractor to note there are total of 8 new rooftop units. Contractor may reuse existing roof curbs to accommodate new units and meet design intent.
Proposed solution for new structural steel frame on existing curbs, provided with new SS curb caps as outlined above, is mechanically acceptable.

1.6 Drawing No.: M103 & M302

.1 Revise: Contractor to note using existing roof penetrations for new refrigerant piping & wiring (low voltage wiring between indoor and outdoor units) will be mechanically acceptable.

1.7 Drawing No.: M201

.1 Revise: Contractor to note, existing DCW main connection for Humidifiers is currently located within Prep Area Room (along gridline V between gridlines 1 & 2). Reuse of existing backflow preventer is mechanically acceptable, with understanding that backflow preventer test report will be provided by contractor as part of close-out documentation.

NOTE: Refer to photos & attachments on following pages.

END OF MECHANICAL ADDENDUM NO. 1

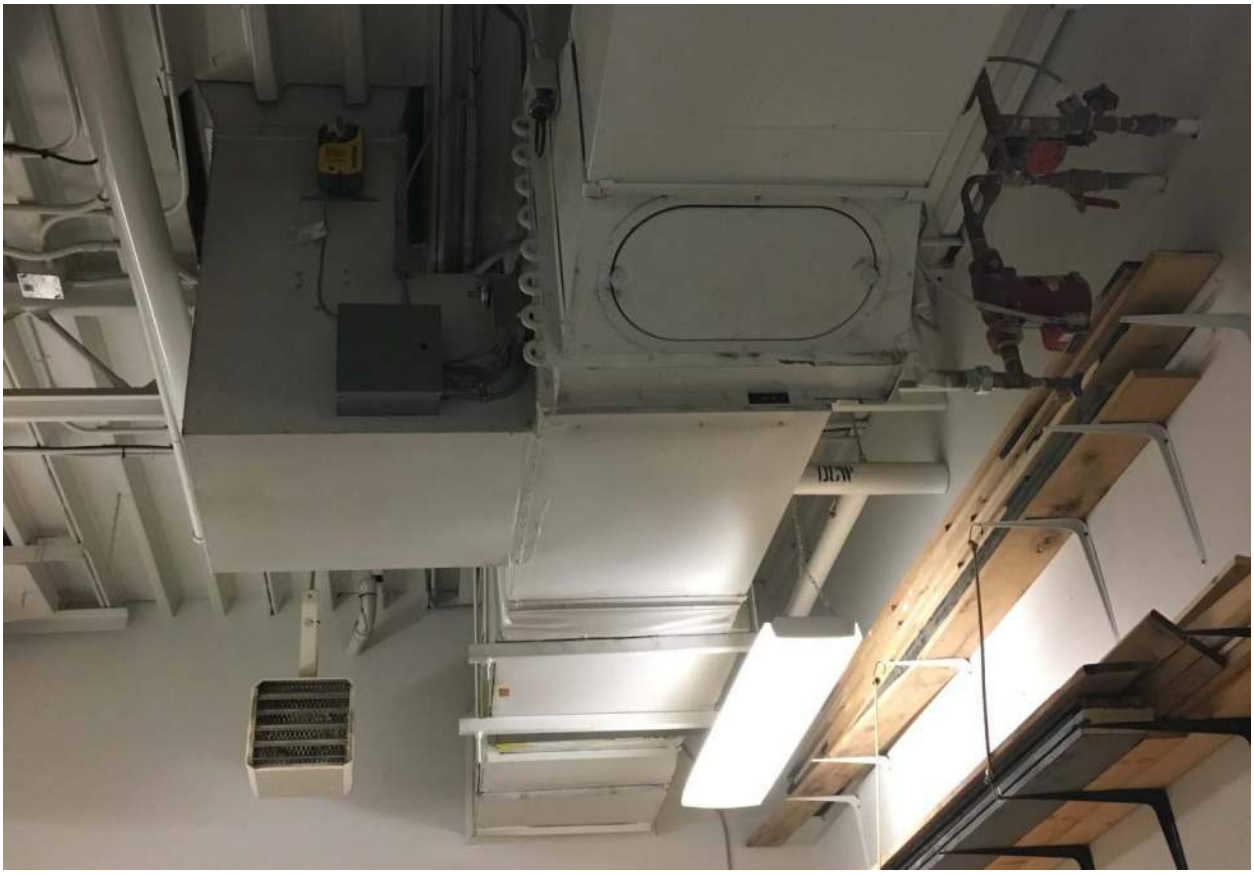


Figure 1 – Existing HWS/R lines for connection service to AHU-7

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

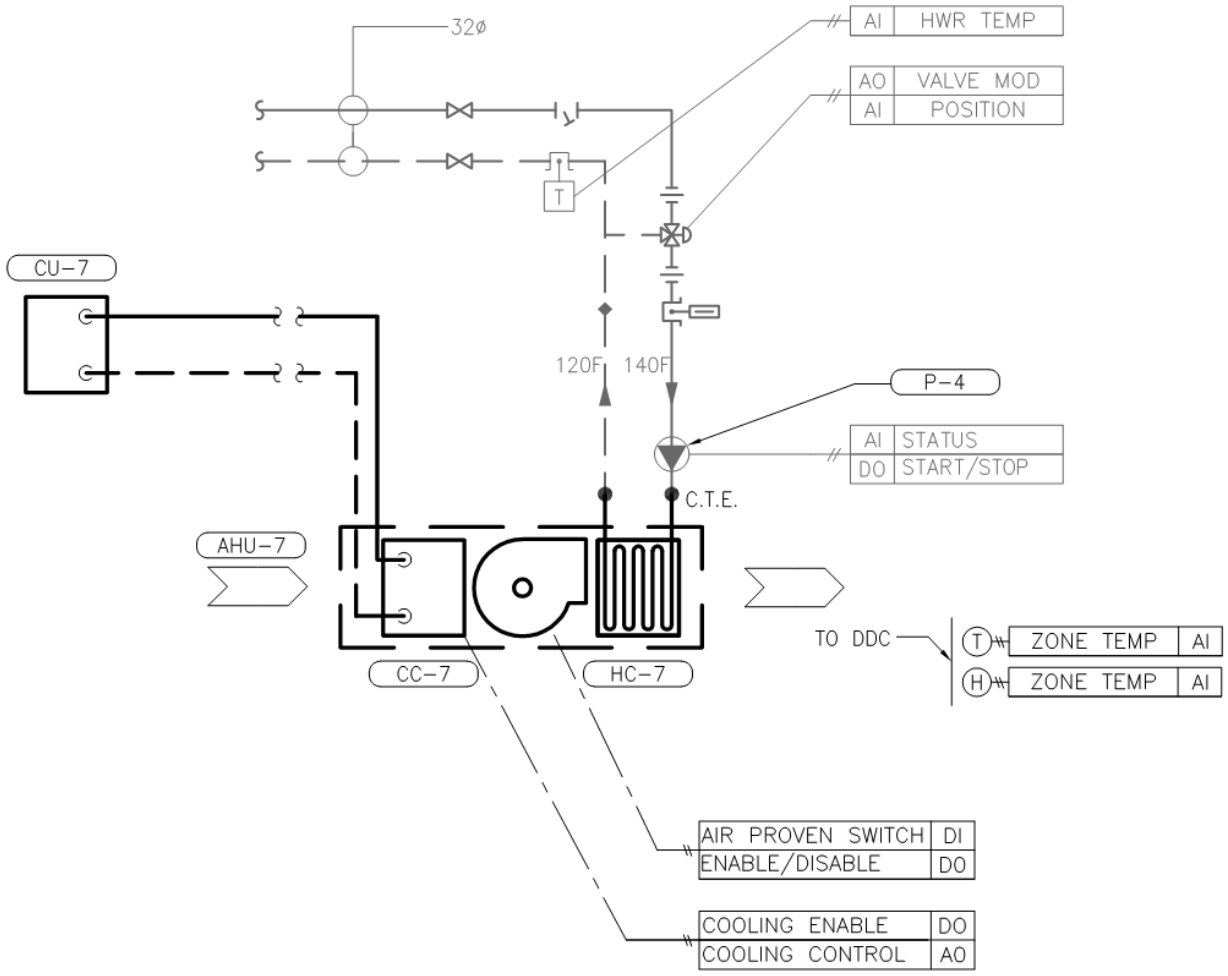
Figure 2 – Existing Condensing Units /w roof curbs & refrigerant piping roof penetrations (typical)

Figure 3 – Existing DCW main connection for Humidifiers

Figure 4 – Existing backflow preventer

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

AHU-7 Equipment Schematic and Schedule revised as follows:



AIR CONDITIONING SCHEDULE

INDOOR UNIT								
TAG	AHU-1	AHU-2	AHU-3	AHU-4	AHU-5	AHU-6	AHU-7	FC-1
LOCATION	PREP AREA (CLEAN)	ARTS HOLDING	ARTS HOLDING	ARTS HOLDING	ARTS HOLDING	ARTS HOLDING	PREP AREA (DIRTY)	GALLERY
SERVICE	PREP AREA (CLEAN)	ARTS HOLDING	GALLERY	GALLERY	GALLERY	GALLERY	AHU-1 TO 6	SERVER COOLING
SYSTEM TYPE	DX SPLIT SYSTEM	DX SPLIT SYSTEM	DX SPLIT SYSTEM	DX SPLIT SYSTEM	DX SPLIT SYSTEM	DX SPLIT SYSTEM	DX SPLIT SYSTEM	DX SPLIT SYSTEM
MANUFACTUER	AAON	AAON	AAON	AAON	AAON	AAON	AAON	AAON
MODEL	H3-BRB-4-0-141D-3AS	H3-BRB-4-0-141D-3AS	H3-BRB-8-0-141D-3BS	H3-BRB-8-0-141D-3BS	H3-BRB-8-0-141D-3BS	H3-BRB-8-0-141D-3BS	H3-BRB-8-0-161C-3DS	H3-BRB-8-0-141D-000
FILTER	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 13
EFFICIENCY (EER)	11.9	11.9	11.7	11.7	10.6	11.7	10.3	11.9
POWER SUPPLY	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P
WEIGHT (KG)	275	275	275	275	275	275	300	228
DIMENSIONS LXWXH (MM)	1880 X 1075 X 560	1880 X 1075 X 560	1880 X 1075 X 560	1880 X 1075 X 560	1880 X 1075 X 560	1880 X 1075 X 560	1880 X 1075 X 560	1550 X 1075 X 560
SUPPLY FAN								
SUPPLY AIR VOLUME (LPS)	378	378	755	755	897	755	897	378
EXTERNAL STATIC (PA)	125	125	125	125	125	125	125	125
TOTAL STATIC (PA)	222	222	326	326	386	326	423	214
FAN MOTOR (HP)	1.3	1.3	2.3	2.3	2.3	2.3	2.3	1.3
HEATING								
HEATER TYPE	ELECTRIC	ELECTRIC	ELECTRIC	ELECTRIC	ELECTRIC	ELECTRIC	HOT WATER COIL	-
INPUT POWER (KW)	7.0	7.0	14.0	14.0	14.0	14.0	38.0 CAPACITY	-
EAT (DEG. C)	12.8	12.8	12.8	12.8	12.8	12.8	-8.9	-
LAT (DEG. C)	23.3	23.3	23.3	23.3	23.3	23.3	23.3	-
COOLING								
SENSIBLE CAPACITY (KW)	7.1	7.1	11.1	11.1	13.1	11.1	15.4	7.1
TOTAL CAPACITY (KW)	10.8	10.8	14.5	14.5	17.4	14.5	20.1	10.8
COIL ROWS	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0
MAX FACE VELOCITY (M/S)	1.1	1.1	2.3	2.3	2.7	2.3	2.7	1.1
EAT DB (DEG. C)	26.7	26.7	26.7	26.7	26.7	26.7	28.3	26.7
EAT WB (DEG. C)	19.4	19.4	19.4	19.4	19.4	19.4	20.0	19.4
LAT DB (DEG. C)	12.9	12.9	14.4	14.4	14.4	14.4	14.4	14.4
LAT WB (DEG. C)	12.8	12.8	13.9	13.9	13.9	13.9	13.9	-
OUTDOOR UNIT								
TAG	CU-1	CU-2	CU-3	CU-4	CU-5	CU-6	CU-7	CU-8
LOCATION	ROOF	ROOF	ROOF	ROOF	ROOF	ROOF	ROOF	ROOF
MODEL	CFA-003-A-A-4-DC00H	CFA-003-A-A-4-DC00H	CFA-004-A-A-8-DC00H	CFA-004-A-A-8-DC00H	CFA-005-A-A-8-DC00H	CFA-004-A-A-8-DC00H	CFA-007-A-A-8-DC00H	CFA-003-A-A-8-DC00H
COMPRESSOR QUANTITY	1	1	1	1	1	1	1	1
POWER SUPPLY	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P	575V/60Hz/3P
WEIGHT (KG)	180	180	206	206	210	206	215	180
REMARKS	1,3,4,5,6,7	1,3,4,5,6,7	1,3,4,5,6,7	1,3,4,5,6,7	1,3,4,5,6,7	1,3,4,5,6,7	1,2,3,4,6,7, 8	1,3,4,6,7,9

NOTES:

1. PREMIUM EFFICIENCY EC MOTORS.
2. 100% OUTDOOR AIR WITH RETURN AIR RECIRCULATION TO PREVENT HEATING COIL FREEZING SIZED AT 30% OF UNIT AIRFLOW.
3. ELECTRICAL TO PROVIDE POWER CONNECTION TO "INDOOR UNIT CONTROL PANEL". PROVIDE /W FACTORY WIRING FROM INDOOR UNIT CONTROL PANEL TO UNIT.
4. REFRIGERANT R-410A. REFRIGERANT LIQUID AND SUCTION LINES SIZE BY MANUFACTURER.
5. ELECTRIC HEATING MODULATED WITH SCR CONTROLLER.
6. PROVIDE 25MM COPPER CONDENSATE DRAIN AND DRAIN PAN FOR INDOOR UNITS.
7. VARIABLE CAPACITY REFRIGERNAT SYSTEM WITH MODULATING COMPRESSOR.
8. CONTRACTOR TO NOTE HOT WATER COIL SERVED BY EXISTING HHW LINES AND EXISTING PUMP. COIL FLOW SHALL NOT EXCEED 1.0 L/S (15 GPM).
9. C/W LOW AMBIENT KIT FOR COOLING IN WINTER SEASON. CONTRACTOR TO INSTALL PER MANUFACTURER RECOMMENDATION.

MECHANICAL MOTORLIST

ALL

EQUIPMENT TAG	EQUIPMENT DESCRIPTION	EQUIPMENT LOCATION	LOAD				EQUIPMENT			STARTER				CONTROL				REMARKS
			MCA	HP	VOLT	PH	S	I	C	S	I	C	TYPE	S	I	C	TYPE	
AHU-1	AIR HANDLING UNIT FOR PREP AREA (CL	PREP AREA (CLEAN)	10.00	1.34	575	3	M	M	E	M	M	E	**INT**	M	M	E	DDC	ALL
AHU-2	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	10.00	1.34	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
AHU-3	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	20.00	2.30	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
AHU-4	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	20.00	2.30	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
AHU-5	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	20.00	2.30	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
AHU-6	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	20.00	2.30	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
AHU-7	AIR HANDLING UNIT 100% OUTDOOR AIR	PREP AREA (DIRTY)	3.00	2.30	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
FC-1	SERVER ROOM COOLING	GALLERY	2.00	1.34	575	3	M	M	E	M	M	E	INT	M	M	E	DDC	ALL
CU-1	CONDENSER FOR AHU-1	ROOF	8.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-2	CONDENSER FOR AHU-2	ROOF	8.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-3	CONDENSER FOR AHU-3	ROOF	9.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-4	CONDENSER FOR AHU-4	ROOF	9.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-5	CONDENSER FOR AHU-5	ROOF	10.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-6	CONDENSER FOR AHU-6	ROOF	9.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-7	CONDENSER FOR AHU-7	ROOF	10.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
CU-8	CONDENSER FOR FC-1	ROOF	8.00	-	575	3	M	M	E	-	-	-	-	-	-	-	-	ALL
H-1	HUMIDIFER FOR AHU-1	PREP AREA (CLEAN)	20.00	-	120	1	M	M	E	M	M	E	INT	M	M	M	DDC	ALL
H-2	HUMIDIFER FOR AHU-2	ARTS HOLDING	20.00	-	120	1	M	M	E	M	M	E	INT	M	M	M	DDC	ALL
H-3	HUMIDIFER FOR AHU-3	ARTS HOLDING	15.00	-	575	3	M	M	E	M	M	E	INT	M	M	M	DDC	ALL
H-4	HUMIDIFER FOR AHU-4	ARTS HOLDING	15.00	-	575	3	M	M	E	M	M	E	INT	M	M	M	DDC	ALL
H-5	HUMIDIFER FOR AHU-5	ARTS HOLDING	15.00	-	575	3	M	M	E	M	M	E	INT	M	M	M	DDC	ALL
H-6	HUMIDIFER FOR AHU-6	PREP AREA (DIRTY)	15.00	-	575	3	M	M	E	M	M	E	INT	M	M	M	DDC	ALL

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

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

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

NOTES 1) ALL DISCONNECT SWITCHES BY DIV. 16

2) SINGLE POINT CONNECTION TO UNIT

Data Sheet

Product Name: EL 005/110-120/1

Product Number: EL Series

AME NOTES:
Humidifier (electric) unit cutsheet for H-1 & H-2.
Refer to mechanical equipment schedule for additional details.

Performance		Dimensions	
Nominal Capacity	5.00 lbs/h	Height	26.40 in.
Rated Capacity	5.50 lbs/h	Width	16.50 in.
Output Range Minimum	1.00 lbs/h	Depth	14.40 in.
Rated Power	1.90 kW	Net Weight	45.0 lbs
Power Circuit	110-120/1/60 V/(phase)/Hz	Full Weight	55.0 lbs
Rated Current	15.60 A	Front Clearance	36.00 in.
Maximum Current	20.00 A	Left Clearance	0.00 in.
Min. Water Pressure	30.00 psig	Right Clearance	0.00 in.
Max. Water Pressure	80.00 psig	Ceiling Clearance	12.00 in.
Controlled Circuits	1	Floor Clearance	24.00 in.
Cylinders	1	Supply Water O D	0.5 in.
Fill Rate	0.20 GPM	Drain Water O D	1 in.
Drain Rate	1.60 GPM	Steam Outlet O D	0.88 in.
		Qty Steam Outlets	1
		Condensate Return	0.38 in.

Data Sheet

Product Name: EL 020/550-600/3

Product Number: EL Series

AME NOTES:
Humidifier (electric) unit cutsheet for H-3 to H-6.
Refer to mechanical equipment schedule for additional details.

Performance		Dimensions	
Nominal Capacity	20.00 lbs/h	Height	26.40 in.
Rated Capacity	22.00 lbs/h	Width	16.50 in.
Output Range Minimum	4.00 lbs/h	Depth	14.40 in.
Rated Power	7.50 kW	Net Weight	45.0 lbs
Power Circuit	550-600/3/60 V/(phase)/Hz	Full Weight	55.0 lbs
Rated Current	7.20 A	Front Clearance	36.00 in.
Maximum Current	15.00 A	Left Clearance	0.00 in.
Min. Water Pressure	30.00 psig	Right Clearance	0.00 in.
Max. Water Pressure	80.00 psig	Ceiling Clearance	12.00 in.
Controlled Circuits	1	Floor Clearance	24.00 in.
Cylinders	1	Supply Water O D	0.5 in.
Fill Rate	0.20 GPM	Drain Water O D	1 in.
Drain Rate	1.60 GPM	Steam Outlet O D	0.88 in.
		Qty Steam Outlets	1
		Condensate Return	0.38 in.

ATTACHMENT #3

to

ADDENDUM #3

MECHANICAL ADDENDUM NO. 2

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

2. SPECIFICATIONS – MECHANICAL

2.1 Section No.: All

.1 Revised: Contractor to note, entire Mechanical Specification was revised. Refer to attachments for latest Mechanical Specification Issued for RFQ.

.1 Note: Contractor to provide separate price for Controls scope of work.

END OF MECHANICAL ADDENDUM NO. 2

ATTACHMENT #4

to

ADDENDUM #3

ELECTRICAL ADDENDUM NO. 1

Electrical Addendum No. 01

PROJECT NAME:	Surrey Arts Centre HVAC	PROJECT NO.:	2-16-172
TO:	AME Group Consulting Engineers	CONTRACT:	ELECTRICAL
		DATE:	November 21, 2016
ISSUED BY:	AES Engineering Ltd.	PAGE:	1 OF 3

NOTE:
1. PRICES ARE REQUESTED FOR THE FOLLOWING CONTEMPLATED CHANGES IN THE WORK.
2. SUBMIT AN ITEMIZED STATEMENT TO THE ENGINEER SHOWING THE PRICE FOR EACH CHANGE AND IDENTIFYING EACH PRICE AS "EXTRA", "CREDIT", OR "NO CHANGE" AS APPLICABLE.
3. WORK ON THIS CONTEMPLATED CHANGE SHALL NOT COMMENCE UNTIL RELEVANT CHANGE ORDER IS ISSUED, BUT ALL OTHER WORK SHALL CONTINUE IN ACCORDANCE WITH CONTRACT DOCUMENTS.

1. Drawing E-001

1.1 Drawing List Update

.1 Drawing List updated with entry for new drawing "E101a—New Electrical Roof Plan".

2. Drawing E-100

2.1 Rooftop Demolition

.1 Delete existing roof top units.

.2 Nine (9) existing luminaires previously denoted as RE revised to RR.

.3 Clarification: existing mechanical units BCU-1 to BCU-6, and F-17 are fed from panel 'NM'.

Electrical Addendum No. 01

3. Drawing E-101

3.1 **Delete Proposed New Boiler Room**

.1 Delete mechanical equipment EF-1, B-1, B-2, FF-1, FF-2, P-1, P-2, P-3, P-4, P-5, P-6 and GFT-1.

.2 Delete three (3) 5-20R duplex GFCI receptacles.

.3 Delete EF-1, FF1-, FF-2, B-1, B-2, P-1, P-2, P-3, P-4, P-5, P-6 and GFT-1.

.4 Delete one (1) heat detector, two (2) fire alarm manual stations, and one (1) fire alarm bell.

.5 Delete two (2) motion detectors.

.6 Delete five (5) LED luminaires.

.7 Delete two (2) low voltage lighting switches.

.8 Delete two (2) LED emergency lighting heads.

.9 Delete two (2) exterior lights.

.10 Delete chiller CH-1.

.11 Delete Drawing Key Notes 2, 3, 5, 6, 7, 8, 9, 10, 13 and 15.

.12 Rooftop items shown on new drawing E-101a.

4. Drawing E-101a

4.1 **New Electrical Roof Plan**

.1 Remove existing six (6) roof top units.

.2 Replace with new units CU-1, CU-2, CU-3, CU-4, CU-5, CU-6, CU-7 and CU-8.

.3 Provide four (4) new roof top receptacles.

Electrical Addendum No. 01

5. Drawing E-102

5.1 **Revised Schedules**

.1 Updated mechanical schedule.

.2 Updated panel 6MECH1 panel schedule.

.3 Revise panel 6MECH1 to 72-cct panel.

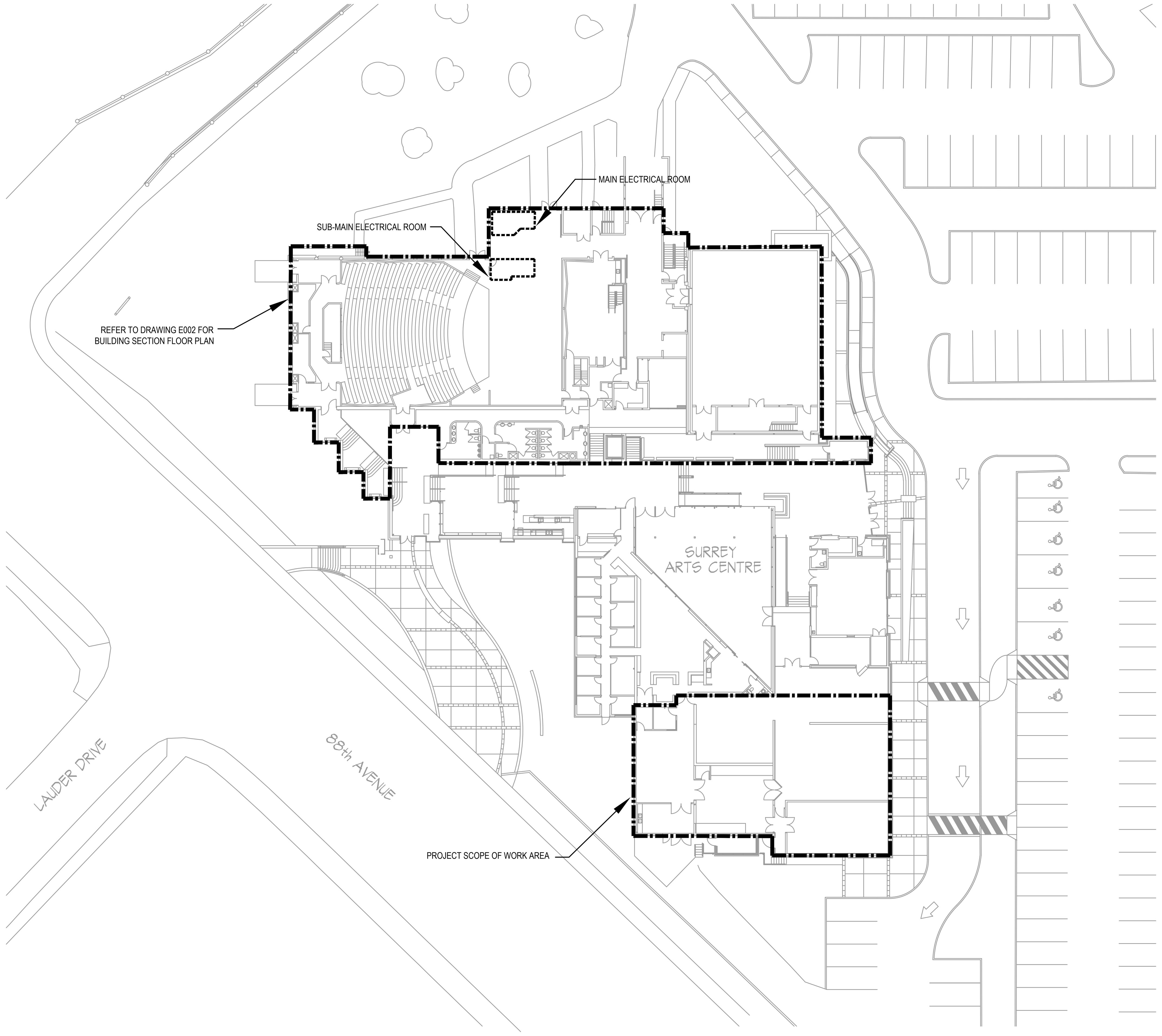
.4 Updated panel 2MECH1 panel schedule.

.5 Revise panel 6MECH1 feeder breaker to 225A.

.6 The feeder from panel 6MECH1 to the 30kVA transformer primary shall be minimum 3#8AWG RW90 in 27mm conduit.

.7 The feeder from the 30kVA transformer secondary to panel 2MECH1 shall be minimum 4#2AWG RW90 in 41mm conduit.

.8 Based on the size of the existing breaker, allow for the existing wire size to be minimum 4#4/0AWG in Drawing Keynote #2.



1 SITE PLAN
0 8m 16m 24m 1:400

PROJECT NORTH

SECTION 28, TOWNSHIP 2 NWD PART NW 1/4, EXCEPT PLAN STAT R/W 6363 & STAT R/W 62493 LMP 1852, 160 AC (WO 6918 WO 7153 WO 8231) PARK- BEAR CREEK

DRAWING LIST

ELECTRICAL POWER, LIGHTING, OTHER EQUIPMENT DESIGN (ENERGY)

BC BUILDING CODE	2012
ELECTRICAL DESIGN:	
ENERGY STANDARD/CODE;	ASHRAE 90.1-2010
POWER COMPLIANCE WITH:	PRESCRIPTIVE
IN ACCORDANCE WITH:	8.1.4 ADDITIONS TO EXISTING BLDGS.
	8.1.5 ALTERATIONS TO EXISTING BLDGS.
LIGHTING COMPLIANCE PATH:	PRESCRITPTIVE
LIGHTING DESIGN METHOD:	SPACE BY SPACE
IN ACCORDANCE WITH:	9.1.2 LIGHTING ALTERATIONS
OTHER EQUIPMENT PATH:	N/A
IN ACCORDANCE WITH:	N/A

SYMBOL LEGEND

LIGHTING

- EMERGENCY/NIGHT LIGHT LUMINAIRE
- SURFACE MOUNTED LUMINAIRE
- CEILING RECESSED LUMINAIRE
- CEILING SUSPENDED LINEAR LUMINAIRE
- FLUORESCENT STRIP LIGHT
- SURFACE MOUNTED LUMINAIRE
- RECESSED DOWN LIGHT
- WALL MOUNTED DOWN LIGHT
- RECESSED STEP LIGHT
- PENDANT LUMINAIRE
- UNDER CUPBOARD STRIP/PUCK LIGHT
- TRACK
- TRACK HEAD
- SPOT LIGHT
- POLE LUMINAIRE
- TWO HEAD POLE LUMINAIRE
- BOLLARD
- INGROUND LIGHTING
- $ SINGLE POLE TOGGLE SWITCH, GANGED AS SHOWN
- LOW VOLTAGE SWITCH, GANGED AS SHOWN
- $3 THREE WAY TOGGLE SWITCH
- OCCUPANCY SENSOR, WALL MOUNTED
- OCCUPANCY SENSOR, CEILING MOUNTED
- D DIMMER SWITCH
- PHOTOCELL
- TC TIME CLOCK
- EX EXIT SIGN - ARROWS AS INDICATED
- EX EXIT SIGN - SINGLE SIDED
- EMERGENCY BATTERY PACK
- DUAL REMOTE EMERGENCY HEADS, CEILING MOUNTED
- DUAL REMOTE EMERGENCY HEADS, WALL MOUNTED
- DUAL EMERGENCY HEADS COMPLETE WITH SELF CONTAINED BATTERY PACK, CEILING MOUNTED
- DUAL EMERGENCY HEADS COMPLETE WITH SELF CONTAINED BATTERY PACK, WALL MOUNTED

SECURITY

- WALL MOUNTED MOTION DETECTOR

POWER

- SINGLE RECEPTACLE
- DUPLEX RECEPTACLE
- FOUR PLEX RECEPTACLE
- ABOVE COUNTER DUPLEX RECEPTACLE
- ABOVE COUNTER FOUR PLEX RECEPTACLE
- 5-20R DUPLEX RECEPTACLE (T-SLOT)
- ABOVE COUNTER 5-20R DUPLEX RECEPTACLE (T-SLOT)
- 1/2 SWITCHED DUPLEX RECEPTACLE
- SPLIT DUPLEX RECEPTACLE
- ABOVE COUNTER SPLIT DUPLEX RECEPTACLE
- ISOLATED GROUND DUPLEX RECEPTACLE
- ISOLATED GROUND FOUR PLEX RECEPTACLE
- GROUND FAULT INTERRUPTER DUPLEX RECEPTACLE
- GROUND FAULT INTERRUPTER FOUR PLEX RECEPTACLE
- ABOVE COUNTER GFCI DUPLEX RECEPTACLE
- FLOOR MOUNTED DUPLEX RECEPTACLE
- FLOOR MOUNTED FOUR PLEX RECEPTACLE
- CEILING MOUNTED DUPLEX RECEPTACLE
- CEILING MOUNTED FOUR PLEX RECEPTACLE
- SYSTEMS FURNITURE POWER WHIP CONNECTION
- SERVICE PAC POLE
- J JUNCTION BOX
- MECHANICAL EQUIPMENT DIRECT CONNECTION
- KITCHEN EQUIPMENT CONNECTION
- $ VARIABLE SPEED SWITCH
- T THERMOSTAT
- BASEBOARD HEATER, WATTAGE AS NOTED ON PLANS
- FORCE FLOW HEATER
- MECHANICAL MOTOR CONNECTION
- DISCONNECT SWITCH
- ## MECHANICAL EQUIPMENT TAG
- CONTACTOR
- MANUAL STARTER
- GROUND BUS
- PANEL BOARD
- CONDUIT RUN UP
- CONDUIT RUN DOWN
- PUSH BUTTON
- EMERGENCY PUSH BUTTON

FIRE ALARM

- SMOKE DETECTOR
- DUCT MOUNTED SMOKE DETECTOR
- S 120V SMOKE ALARM C/W BATTERY BACKUP
- THERMAL DETECTOR
- DUCT MOUNTED SMOKE DETECTOR
- FIRE ALARM PIEZO WITH SILENCE SWITCH
- FIRE ALARM HORN (W/STROBE)
- F FIRE ALARM PULL STATION
- F FIRE ALARM BELL
- FIRE ALARM GONG
- FIRE ALARM GONG W/STROBE
- F FIRE ALARM HORN
- F FIRE ALARM STROBE
- FIRE ALARM REMOTE TROUBLE
- F FIREFIGHTERS TELEPHONE
- F CEILING MOUNTED FIRE ALARM SPEAKER
- F WALL MOUNTED FIRE ALARM SPEAKER
- END OF LINE RESISTER
- FAP FIRE ALARM PANEL
- FAA FIRE ALARM ANNUNCIATOR
- FLO SPRINKLER FLOW SWITCH
- SPRINKLER VALVE SUPERVISORY

ABBREVIATIONS

NOTE	EQUIPMENT SHOWN DOTTED IS EXISTING AND TO REMAIN UNLESS INDICATED OTHERWISE
AC	ABOVE COUNTER
D	INDICATES CIRCUIT TO BE DEDICATED
NL	NIGHT LIGHT
E	EXISTING DEVICE TO REMAIN
R	EXISTING DEVICE TO BE REMOVED
RR	EXISTING DEVICE TO BE REMOVED & RELOCATED/REINSTALLED
RE	EXISTING DEVICE IN NEW RELOCATED POSITION
RP	EXISTING DEVICE TO BE REPLACED WITH NEW
WP	WEATHER PROOF

LINE TYPES

-----------	DOTTED/DASHED LINES ON DEMO DRAWINGS INDICATES EXISTING TO BE REMOVED, UNLESS OTHERWISE NOTED.
———	THIN LINE INDICATES EXISTING, UNLESS OTHERWISE NOTED.
———	THICK LINES INDICATE NEW, UNLESS OTHERWISE NOTED.

NOTE: NOT EVERY SYMBOL IS USED

No.	DATE (dd/mm/yr)	REVISION
3.	21/11/2016	ISSUED FOR ADDENDUM (1)
2.	16/09/2016	ISSUED FOR RFQ AND BP
1.	30/08/2016	ISSUED FOR REVIEW

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

PROJECT TITLE

SURREY ARTS CENTRE HVAC

13750 88th AVENUE, SURREY, BC

CITY OF SURREY

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

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

cta: date:

AME Group consulting mechanical engineers
VICTORIA T. 250-382-5999 F. 250-382-5998 721 JOHNSON ST VICTORIA, BC V8W 1M8 ☐
VANCOUVER T. 604-684-5995 F. 604-684-5993 1100 - 808 W HASTINGS ST VANCOUVER, BC V6C 2X4 ☒
CALGARY T. 403-252-2333 F. 403-253-3324 710 - 1122 4TH STREET SW CALGARY, AB T2R 1M1 ☐

CONSULTANT
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1330 Granville St.
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CALGARY | VANCOUVER | VICTORIA
Designing A Better Tomorrow

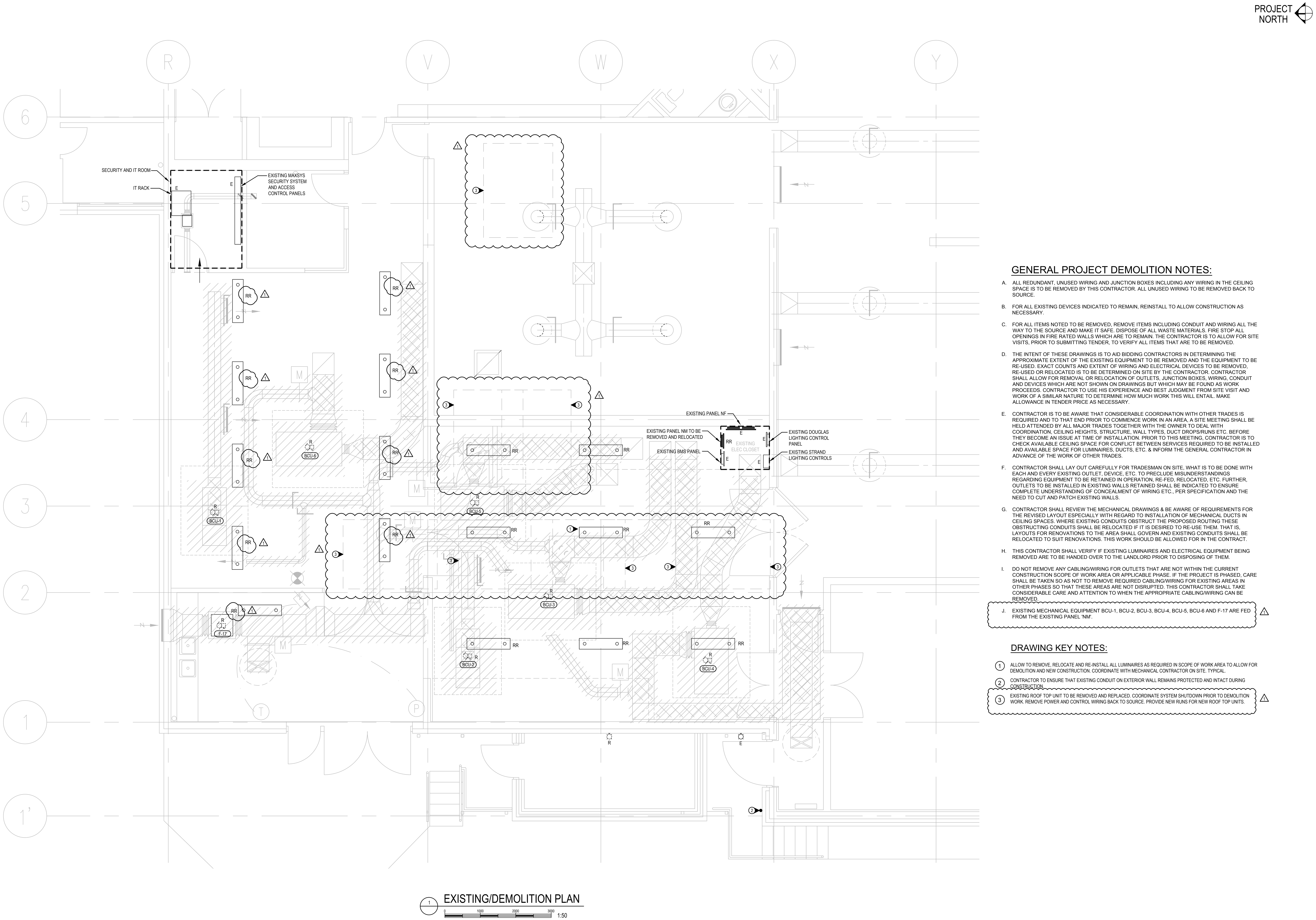
SHEET TITLE

ELECTRICAL SITE PLAN, SYMBOL LEGEND & DRAWING LIST

PROJECT No.	2-16-172
DRAWN	HB/EH
CHECKED	HB/BL
SCALE	AS NOTED
DATE	AUG. 2016
PRINTED	-

DRAWING No.

E001



1 EXISTING/DEMOLITION PLAN
1:50

GENERAL PROJECT DEMOLITION NOTES:

A. ALL REDUNDANT, UNUSED WIRING AND JUNCTION BOXES INCLUDING ANY WIRING IN THE CEILING SPACE IS TO BE REMOVED BY THIS CONTRACTOR. ALL UNUSED WIRING TO BE REMOVED BACK TO SOURCE.

B. FOR ALL EXISTING DEVICES INDICATED TO REMAIN, REINSTALL TO ALLOW CONSTRUCTION AS NECESSARY.

C. FOR ALL ITEMS NOTED TO BE REMOVED, REMOVE ITEMS INCLUDING CONDUIT AND WIRING ALL THE WAY TO THE SOURCE AND MAKE IT SAFE. DISPOSE OF ALL WASTE MATERIALS. FIRE STOP ALL OPENINGS IN FIRE RATED WALLS WHICH ARE TO REMAIN. THE CONTRACTOR IS TO ALLOW FOR SITE VISITS, PRIOR TO SUBMITTING TENDER, TO VERIFY ALL ITEMS THAT ARE TO BE REMOVED.

D. THE INTENT OF THESE DRAWINGS IS TO AID BIDDING CONTRACTORS IN DETERMINING THE APPROXIMATE EXTENT OF THE EXISTING EQUIPMENT TO BE REMOVED AND THE EQUIPMENT TO BE RE-USED. EXACT COUNTS AND EXTENT OF WIRING AND ELECTRICAL DEVICES TO BE REMOVED, RE-USED OR RELOCATED IS TO BE DETERMINED ON SITE BY THE CONTRACTOR. CONTRACTOR SHALL ALLOW FOR REMOVAL OR RELOCATION OF OUTLETS, JUNCTION BOXES, WIRING, CONDUIT AND DEVICES WHICH ARE NOT SHOWN ON DRAWINGS BUT WHICH MAY BE FOUND AS WORK PROCEEDS. CONTRACTOR TO USE HIS EXPERIENCE AND BEST JUDGMENT FROM SITE VISIT AND WORK OF A SIMILAR NATURE TO DETERMINE HOW MUCH WORK THIS WILL ENTAIL. MAKE ALLOWANCE IN TENDER PRICE AS NECESSARY.

E. CONTRACTOR IS TO BE AWARE THAT CONSIDERABLE COORDINATION WITH OTHER TRADES IS REQUIRED AND TO THAT END PRIOR TO COMMENCE WORK IN AN AREA, A SITE MEETING SHALL BE HELD ATTENDED BY ALL MAJOR TRADES TOGETHER WITH THE OWNER TO DEAL WITH COORDINATION, CEILING HEIGHTS, STRUCTURE, WALL TYPES, DUCT DROPS/RUNS ETC. BEFORE THEY BECOME AN ISSUE AT TIME OF INSTALLATION. PRIOR TO THIS MEETING, CONTRACTOR IS TO CHECK AVAILABLE CEILING SPACE FOR CONFLICT BETWEEN SERVICES REQUIRED TO BE INSTALLED AND AVAILABLE SPACE FOR LUMINAIRES, DUCTS, ETC. & INFORM THE GENERAL CONTRACTOR IN ADVANCE OF THE WORK OF OTHER TRADES.

F. CONTRACTOR SHALL LAY OUT CAREFULLY FOR TRADESMAN ON SITE, WHAT IS TO BE DONE WITH EACH AND EVERY EXISTING OUTLET, DEVICE, ETC. TO PRECLUDE MISUNDERSTANDINGS REGARDING EQUIPMENT TO BE RETAINED IN OPERATION, RE-FED, RELOCATED, ETC. FURTHER, OUTLETS TO BE INSTALLED IN EXISTING WALLS RETAINED SHALL BE INDICATED TO ENSURE COMPLETE UNDERSTANDING OF CONCEALMENT OF WIRING ETC., PER SPECIFICATION AND THE NEED TO CUT AND PATCH EXISTING WALLS.

G. CONTRACTOR SHALL REVIEW THE MECHANICAL DRAWINGS & BE AWARE OF REQUIREMENTS FOR THE REVISED LAYOUT ESPECIALLY WITH REGARD TO INSTALLATION OF MECHANICAL DUCTS IN CEILING SPACES. WHERE EXISTING CONDUITS OBSTRUCT THE PROPOSED ROUTING THESE OBSTRUCTING CONDUITS SHALL BE RELOCATED IF IT IS DESIRED TO RE-USE THEM. THAT IS, LAYOUTS FOR RENOVATIONS TO THE AREA SHALL GOVERN AND EXISTING CONDUITS SHALL BE RELOCATED TO SUIT RENOVATIONS. THIS WORK SHOULD BE ALLOWED FOR IN THE CONTRACT.

H. THIS CONTRACTOR SHALL VERIFY IF EXISTING LUMINAIRES AND ELECTRICAL EQUIPMENT BEING REMOVED ARE TO BE HANDED OVER TO THE LANDLORD PRIOR TO DISPOSING OF THEM.

I. DO NOT REMOVE ANY CABLING/WIRING FOR OUTLETS THAT ARE NOT WITHIN THE CURRENT CONSTRUCTION SCOPE OF WORK AREA OR APPLICABLE PHASE. IF THE PROJECT IS PHASED, CARE SHALL BE TAKEN SO AS NOT TO REMOVE REQUIRED CABLING/WIRING FOR EXISTING AREAS IN OTHER PHASES SO THAT THESE AREAS ARE NOT DISRUPTED. THIS CONTRACTOR SHALL TAKE CONSIDERABLE CARE AND ATTENTION TO WHEN THE APPROPRIATE CABLING/WIRING CAN BE REMOVED.

J. EXISTING MECHANICAL EQUIPMENT BCU-1, BCU-2, BCU-3, BCU-4, BCU-5, BCU-6 AND F-17 ARE FED FROM THE EXISTING PANEL 'NM'. (1)

DRAWING KEY NOTES:

(1) ALLOW TO REMOVE, RELOCATE AND RE-INSTALL ALL LUMINAIRES AS REQUIRED IN SCOPE OF WORK AREA TO ALLOW FOR DEMOLITION AND NEW CONSTRUCTION. COORDINATE WITH MECHANICAL CONTRACTOR ON SITE. TYPICAL.

(2) CONTRACTOR TO ENSURE THAT EXISTING CONDUIT ON EXTERIOR WALL REMAINS PROTECTED AND INTACT DURING CONSTRUCTION.

(3) EXISTING ROOF TOP UNIT TO BE REMOVED AND REPLACED. COORDINATE SYSTEM SHUTDOWN PRIOR TO DEMOLITION WORK. REMOVE POWER AND CONTROL WIRING BACK TO SOURCE. PROVIDE NEW RUNS FOR NEW ROOF TOP UNITS. (1)

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13750 88th AVENUE, SURREY, BC

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cta: date:

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AES
CALGARY | VANCOUVER | VICTORIA
Designing A Better Tomorrow

SHEET TITLE

EXISTING/DEMO PLAN

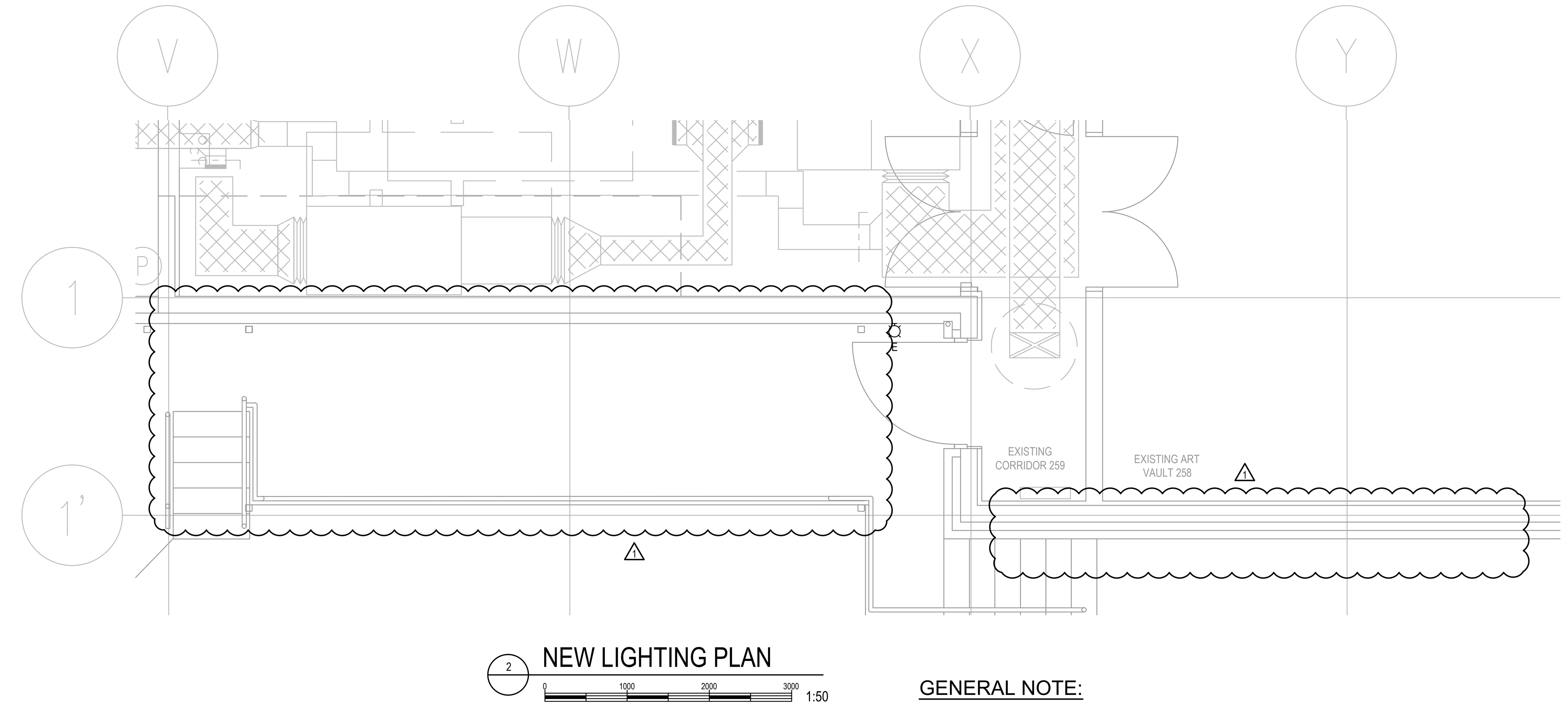
PROJECT No.	2-16-172
DRAWN	HB/EH
CHECKED	HB/BL
SCALE	AS NOTED
DATE	AUG. 2016
PRINTED	-

DRAWING No.

E100

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

PROJECT NORTH



GENERAL NOTE:

A. PROVIDE LAMICOID LABELING FOR ALL DISCONNECT SWITCHES, PANEL BOARDS AND JUNCTION BOXES TO MATCH EXISTING BULDING STANDARD. LABELING TO INDICATE EQUIPMENT NAME, VOLTAGE/AMPERE RATING AND CIRCUIT NUMBERS AS REQUIRED.

B. MINIMUM 12AWG, COPPER, RW90 WIRING IS TO BE USED FOR ALL ELECTRICAL CONNECTIONS IN THE BUILDING. ALL WIRING SHALL BE RUN IN EMT CONDUIT.

C. FINAL CONNECTIONS TO MOTORS SHALL BE IN FLEXIBLE, LIQUID TIGHT CONDUIT, MAXIMUM LENGTH OF 1.5METERS.

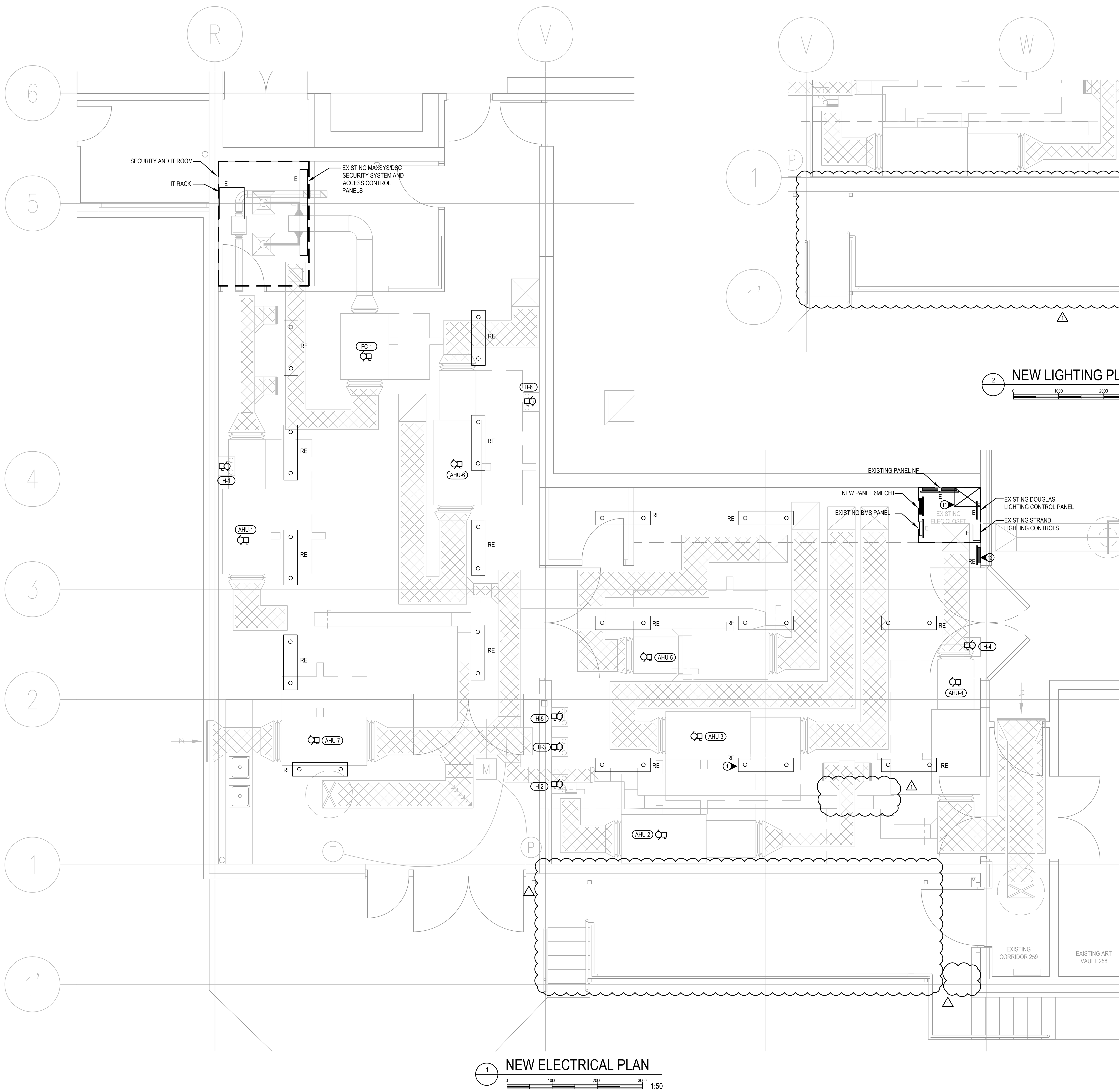
D. ROOFTOP ELECTRICAL WIRING SHALL RUN IN EMT CONDUIT AND TERMINATE IN A PULL BOX ON THE CEILING. FLEXIBLE, METALLIC, LIQUID TIGHT CONDUIT SHALL BE USED TO RUN FROM THE PULL BOX AND PENETRATE THE ROOF SLAB AND TO THE APPROPRIATE CONNECTION LOCATIONS. ROOFTOP PENETRATIONS SHALL BE PROPERLY SEALED TO BE WATER TIGHT AS REQURIED.

E. CONTRACTOR IS TO ALLOW TO REMOVE, RELOCATE AND REINSTALL LUMINAIRES, FIRE ALARM DEVICES, CONDUIT, WIRING AND ANY OTHER ELECTRICAL DEVICES AS REQUIRED IN SCOPE OF WORK AREAS. EQUIPMENT THAT IS RELOCATED IS TO BE TESTED & RE-VERIFIED AS REQUIRED BY CODE. RELOCATE AND REMOUNT TO BUILDING STRUCTURE ANY ELECTRICAL EQUIPMENT THAT IS SUPPORTED BY MECHANICAL EQUIPMENT BEING REMOVED OR RELOCATED. COORDINATE WITH MECHANICAL FOR LOCATIONS WHERE EQUIPMENT IS BEING DEMOLISHED AND/OR RELOCATED. CONTRACTOR TO PERFORM SITE VISIT AND REFER TO DEMOLITION NOTES ON DRAWING E100 AND MAKE ALLOWANCES IN TENDER PRICE AS NECESSARY.

F. MECHANICAL EQUIPMENT IS SHOWN ON FLOOR PLANS FOR REFERENCE ONLY. CONTRACTOR TO REVIEW MECHANICAL DRAWINGS AND COORDINATE WITH MECHANICAL CONTRACTOR FOR EXACT LOCATIONS/ELEVATIONS OF EQUIPMENT AND ELECTRICAL REQUIREMENTS PRIOR TO INSTALLATION. SOME EQUIPMENT IS MOUNTED AT FLOOR LEVEL AND SOME EQUIPMENT IS MOUNTED AT A HIGH ELEVATION.

DRAWING KEY NOTES:

1. ALLOW TO REMOVE, RELOCATE AND RE-INSTALL ALL LUMINAIRES AS REQUIRED IN SCOPE OF WORK AREA TO ALLOW FOR DEMOLITION AND NEW CONSTRUCTION. COORDINATE WITH MECHANICAL CONTRACTOR ON SITE. TYPICAL.
2. NOT USED
3. NOT USED
4. NOT USED
5. NOT USED
6. NOT USED
7. NOT USED
8. NOT USED
9. NOT USED
10. NOT USED
11. PROVIDE NEW 30KVA DRY TYPE GENERAL PURPOSE TRANSFORMER, APPROVED MANUFACTURER DELTA TRANSFORMERS MODEL CD3A OR APPROVED EQUAL. TRANSFORMER SHALL BE SUSPENDED AT HIGH ELEVATION ABOVE EXISTING PANELS. PROVIDE PROPER SEISMIC SUPPORT AS REQUIRED, REFER TO ELECTRICAL SPECIFICATIONS SECTION 31.
12. RELOCATED PANEL NM (NEW PANEL 2MECH1) SHALL BE INSTALLED OUTSIDE OF ELECTRICAL CLOSET DUE TO SPACE. CONTRACTOR TO DETERMINE BEST LOCATION ON SITE AND ENSURE ALL CLEARANCES ARE MET AS REQUIRED BY CODE.
13. NOT USED
14. NOT USED
15. NOT USED



No.	DATE (dd/mm/yr)	REVISION
3.	21/11/2016	ISSUED FOR ADDENDUM 1
2.	16/09/2016	ISSUED FOR RFQ AND BP
1.	30/08/2016	ISSUED FOR REVIEW

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

PROJECT TITLE

SURREY ARTS CENTRE HVAC

13750 88th AVENUE, SURREY, BC

CITY OF SURREY

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

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

cta: date:

AME Group consulting mechanical engineers
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VANCOUVER T. 604-684-5995 F. 604-684-5993 1100 - 808 W HASTINGS ST VANCOUVER, BC V6C 2X4
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Designing A Better Tomorrow

SHEET TITLE

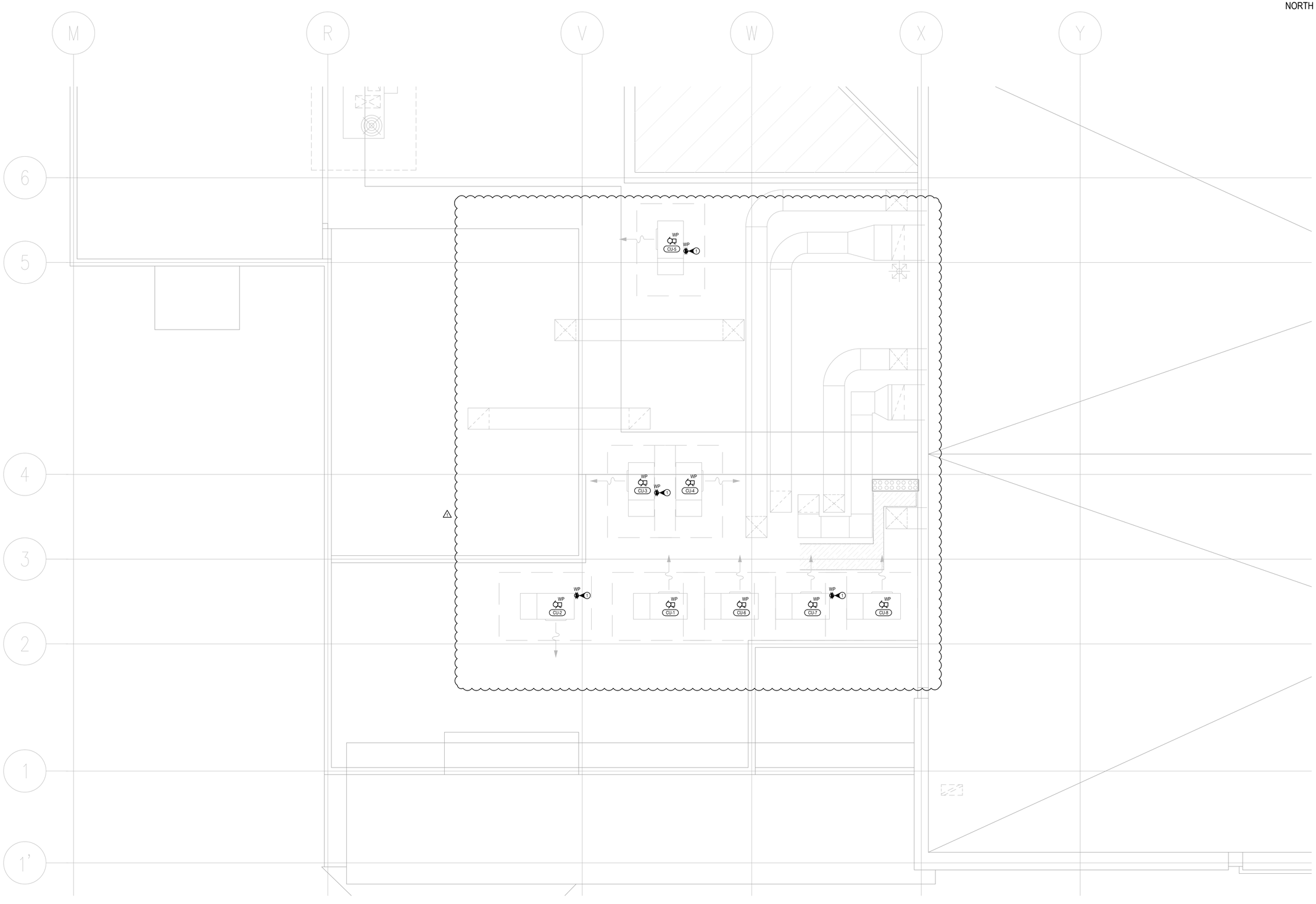
NEW ELECTRICAL PLAN

PROJECT No.	2-16-172
DRAWN	HB/EH
CHECKED	HB/BL
SCALE	AS NOTED
DATE	AUG. 2016
PRINTED	-

DRAWING No.

E101

CHERNOFF THOMPSON ARCHITECTS



PROJECT NORTH

NEW ELECTRICAL ROOF PLAN

1:50

DRAWING KEY NOTE:

1. PROVIDE 5-20R CONVENIENCE RECEPTACLE FOR CHILLER ON THE ROOF. FEED FROM DEDICATED 20AMP BREAKER IN PANEL 2MECH1. PROVIDE A WEATHER PROOF, IN-USE COVER FOR RECEPTACLE.

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PROJECT TITLE

SURREY ARTS CENTRE HVAC

13750 88th AVENUE, SURREY, BC

CITY OF SURREY

cta: date:

CONSULTANT

SHEET TITLE

NEW ELECTRICAL ROOF PLAN

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E101a

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110-1281 WEST GEORGIA, VANCOUVER, B.C. V6E 3J5
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													STARTER				DISC.			CONTROL				
UNIT No.	UNIT DESCRIPTION	UNIT LOCATION	V	Ph	MCA/FLA/KW /HP		(A)	(VA)	BREAKER	FEEDER	CONDUIT	PANEL	TYPE	SUPPLIED	INSTALLED	WIRED	SUPPLIED	INSTALLED	WIRED	TYPE	SUPPLIED	INSTALLED	WIRED	NOTES
AIR HANDLING UNITS																								
AHU-1	AIR HANDLING UNIT FOR PREP AREA (CLEAN)	PREP AREA (CLEAN)	575	3	10	MCA	8	7967	20	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
AHU-2	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	575	3	10	MCA	8	7967	20	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
AHU-3	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	575	3	20	MCA	16	15935	40	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
AHU-4	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	575	3	20	MCA	16	15935	40	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
AHU-5	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	575	3	20	MCA	16	15935	40	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
AHU-6	AIR HANDLING UNIT FOR ART GALLERY	ARTS HOLDING	575	3	20	MCA	16	15935	40	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
AHU-7	AIR HANDLING UNIT 100% OUTDOOR AIR	PREP AREA (DIRTY)	575	3	3	MCA	2	2390	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
FAN COILS																								
FC-1	SERVER ROOM COOLING	GALLERY	575	3	2	MCA	2	1593	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CONDENSING UNITS																								
CU-1	CONDENSER FOR AHU-1	ROOF	575	3	8	MCA	6	6374	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-2	CONDENSER FOR AHU-2	ROOF	575	3	8	MCA	6	6374	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-3	CONDENSER FOR AHU-3	ROOF	575	3	9	MCA	7	7171	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-4	CONDENSER FOR AHU-4	ROOF	575	3	9	MCA	7	7171	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-5	CONDENSER FOR AHU-5	ROOF	575	3	10	MCA	8	7967	20	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-6	CONDENSER FOR AHU-6	ROOF	575	3	9	MCA	7	7171	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-7	CONDENSER FOR AHU-7	ROOF	575	3	10	MCA	8	7967	20	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
CU-8	CONDENSER FOR AHU-8	ROOF	575	3	8	MCA	6	6374	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	E	
HUMIDIFIER																								
H-1	HUMIDIFIER FOR AHU-1	PREP AREA (CLEAN)	120	1	20	MCA	16	1920	20	2c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	M	
H-2	HUMIDIFIER FOR AHU-2	ARTS HOLDING	120	1	20	MCA	16	1920	20	2c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	M	
H-3	HUMIDIFIER FOR AHU-3	ARTS HOLDING	575	3	15	MCA	12	11951	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	M	
H-4	HUMIDIFIER FOR AHU-4	ARTS HOLDING	575	3	15	MCA	12	11951	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	M	
H-5	HUMIDIFIER FOR AHU-5	ARTS HOLDING	575	3	15	MCA	12	11951	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	M	
H-6	HUMIDIFIER FOR AHU-6	PREP AREA (DIRTY)	575	3	15	MCA	12	11951	15	3c 12	21mm	SEE SCHEDULE	INT	M	M	E	E	E	E	DDC	M	M	M	

GENERAL NOTES FOR MECH EQUIPMENT SCHEDULE:

A. CONTRACTOR TO OBTAIN AND REVIEW MECHANICAL DRAWINGS AND SCHEDULES DURING TENDER TO ENSURE ALL SCOPE REQUIRED FOR ELECTRICAL CONNECTION TO MECHANICAL UNITS HAS BEEN ALLOWED FOR. NO EXTRAS WILL BE ALLOWED FOR STARTERS, DISCONNECTS, OR ANY OTHER EQUIPMENT IF IT IS SHOWN ON THE MECHANICAL TENDER DRAWINGS TO BE SUPPLIED BY ELECTRICAL.
B. CONTRACTOR TO REVIEW MECH SHOP DRAWINGS AND CONFIRM ALL EQUIPMENT LOADS, OVERCURRENT PROTECTION, WIRE AND CONDUIT SIZES AND MOUNTING HEIGHTS PRIOR TO ROUGH-IN.
C. CONTRACTOR TO INSPECT ALL MECH EQUIPMENT LABELS ON SITE PRIOR TO INSTALLATION AND INFORM THE CONSULTANT OF ANY DISCREPANCIES. FOLLOW THE MECH LABELS FOR FINAL SIZE OF THE BREAKERS AS PER C.E.C.
D. ALL MOTORS LOCATED OUTSIDE TO C/W WEATHER PROOF DISCONNECT SWITCHES & RAIN TIGHT CONNECTIONS.
E. DIV. 16 TO PROVIDE SEPARATE LOCAL DISCONNECT SWITCH FOR MECH EQUIPMENT IF NOT SUPPLIED WITH THE PACKAGED UNIT.
F. ALL MOTOR RATED RELAYS ARE TO BE WITH A HOA POSITION SWITCH, MOTOR PROTECTION SWITCH AND 24 VAC CONTROL CIRCUIT.
G. ELECTRICAL CONTRACTOR IS TO COORDINATE LOCATION OF ALL ELECTRICAL CONNECTIONS AND JUNCTION BOXES BEING PROVIDED WITH MECHANICAL DRAWINGS AND MECHANICAL CONTRACTOR ON SITE.
H. ELECTRICAL CONTRACTOR TO PROVIDE ALL WIRING, CONDUIT AND CONNECTIONS TO MOTOR STARTERS AND VFD'S AND FROM STARTERS/VFDS TO THE MOTORS AS REQURIED.

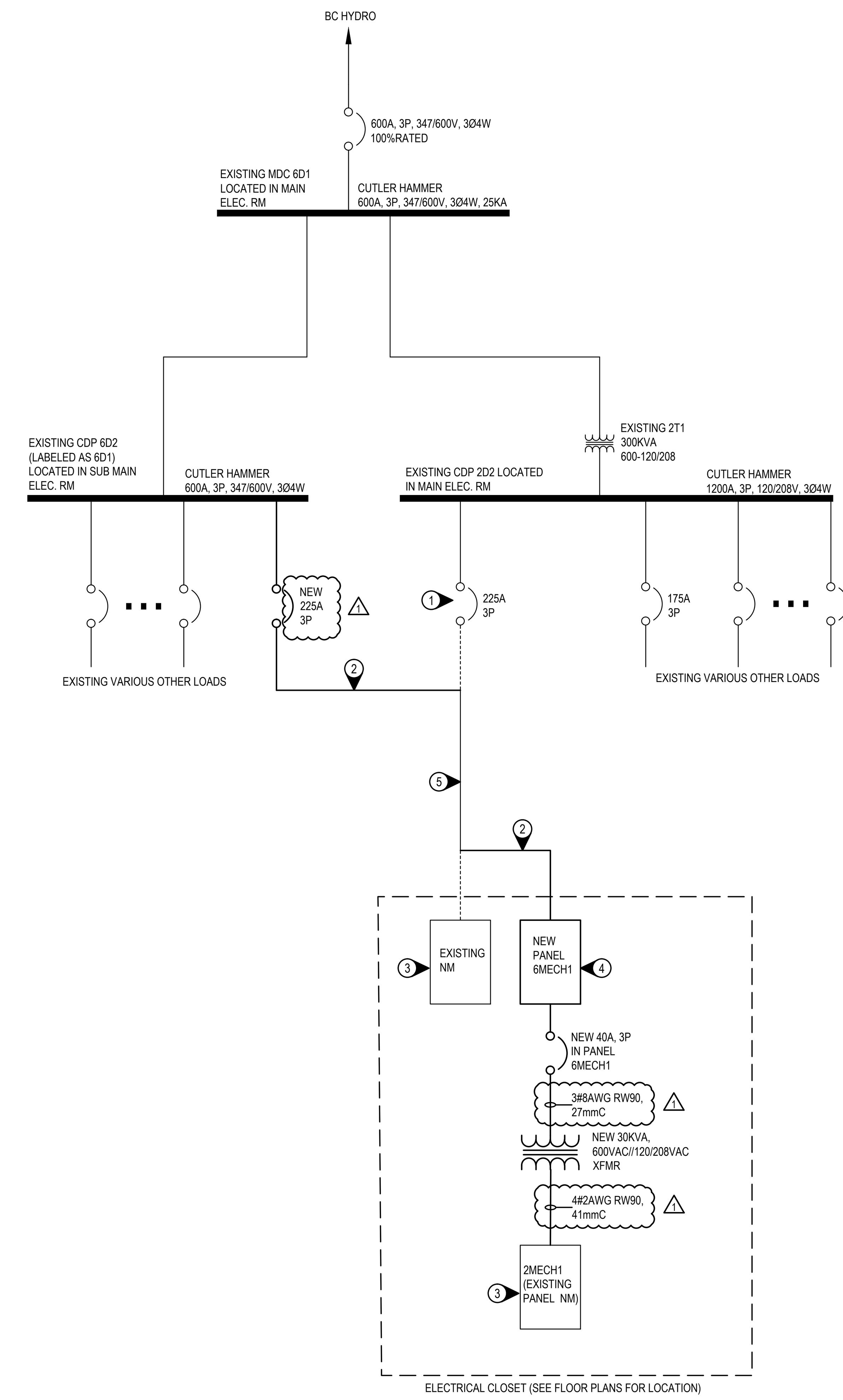
MECH MOTOR SCHEDULE ABBREVIATIONS:

(A) SUPPLIED BY:
E = ELECTRICAL
M = MECHANICAL

(B) STARTER TYPE:
MAN = MANUAL STARTER
MAG = MAGNETIC STARTER W/ HOA SWITCH W/ AUX. CONTACTS
MRR = MOTOR RATED RELAY C/W 24VAC COIL, HOA SWITCH AND MOTOR PROTECTION SWITCH
INT = INTEGRAL TO UNIT
VFD = VARIABLE FREQUENCY DRIVE COMPLETE WITH BYPASS AND
HOA = MAGNETIC STARTER COMPLETE WITH HAND/ON-OFF/AUTO SWITCH AND AUX STATUS CONTACT
PCS = PACKAGED CONTROL SYSTEM
RVS = REDUCED VOLTAGE STARTER
SW OR WS = WALL SWITCH
CP = CONTROL PANEL

(C) CONTROL TYPE:
BMS = BUILDING MANAGEMENT SYSTEM
D = DDC SYSTEM
ES = END SWITCH
ET = LINE VOLTAGE THERMOSTAT
TSTAT = THERMOSTAT
FA = FIRE ALARM
FS = FLOW SWITCH
GS = GAS SENSOR
H = HUMIDITY SENSOR
I = INTERLOCK
LS = LEVEL SWITCH
PS = PRESSURE SWITCH
TC = TIME CLOCK
T = LOW VOLTAGE TSTAT OR SENSOR
TS = TAMPER SWITCH
FAP = FIRE ALARM PANEL
CC = CHEMICAL CONTROLLER
LGP = LIFE GUARD PANEL
C = CONTINUOUS OPERATION
SW OR WS = WALL SWITCH
TSTAT = THERMOSTAT
RSTAT = REVERSE ACTING THERMOSTAT
VS = VARIABLE SPEED CONTROL SWITCH

1 MECHANICAL SCHEDULE
NTS



2 PARTIAL SINGLE LINE DIAGRAM
NTS

DRAWING KEY NOTES:

1. EXISTING FEEDERS TO BE DISCONNECTED FROM BREAKER IN CDP 2D2 AND BREAKER TO BE LABELED AS SPARE.
2. DISCONNECT FEEDERS FROM EXISTING PANEL NM AND RECONNECT TO NEW PANEL 6MECH1. FEEDERS AT THE SOURCE END SHALL BE RE-ROUTED AND EXTENDED AS REQUIRED TO BE CONNECTED FROM A NEW BREAKER IN CDP 6D2 IN SUB MAIN ELECTRICAL ROOM. CONTRACTOR SHALL VERIFY SIZE OF FEEDERS ON SITE AND NOTIFY ENGINEER PRIOR TO ORDERING AND INSTALLING BREAKER IN CDP 6D2. BASED ON THE SIZE OF THE EXISTING BREAKER, ALLOW FOR THE EXISTING WIRE SIZE TO BE MINIMUM 4#4/0AWG.
3. RE-USE EXISTING PANEL NM AND RE-FEED FROM PANEL 6MECH1 VIA NEW STEP DOWN TRANSFORMER AS INDICATED ON SINGLE LINE DIAGRAM. EXISTING LOADS ON PANEL NM WHICH ARE NOT NOTED TO BE REMOVED SHALL REMAIN AS INDICATED ON UPDATED PANEL SCHEDULES. RELOCATE BREAKERS AS REQUIRED TO ALLOW FOR INSTALLATION OF NEW BREAKERS. EXTEND CONDUIT AND WIRING AS REQUIRED TO RE-FEED THE EXISTING LOADS FROM NEW PANEL LOCATION. RENAME PANEL NM AS PANEL 2MECH1 AND PROVIDE NEW BREAKERS FOR NEW LOADS AS REQUIRED.
4. PROVIDE A NEW 225 AMP RATED, 347/600VAC, 72 CIRCUIT PANEL 6MECH1 IN PLACE OF PANEL NM. RE-USE EXISTING FEEDERS TO CONNECT TO PANEL 6MECH1. PROVIDE NEW BREAKERS AS INDICATED TO FEED THE NEW MECHANICAL EQUIPMENT.
5. EXISTING FEEDERS FROM CDP 2D2 TO PANEL NM ARE TO BE RE-USED TO FEED NEW PANEL 6MECH1.

GENERAL NOTES:

A. PROVIDE LAMICOID LABELING FOR ALL DISCONNECT SWITCHES, PANEL BOARDS AND JUNCTION BOXES TO MATCH EXISTING BULDING STANDARD. LABELING TO INDICATE EQUIPMENT NAME, VOLTAGE/AMPERE RATING AND CIRCUIT NUMBER AS REQUIRED.

B. SINGLE LINE DIAGRAM (SLD) HAS BEEN PROVIDED FROM SITE OBSERVATIONS. CONTRACTOR TO VERIFY SLD ON SITE AND NOTIFY ENGINEER OF ANY DISCREPANCIES.

NEW PANEL 6MECH1 (225AMP, 347/600VAC, 72 CIRCUIT)

DESIGNATION	BKR	CCT. NO.	PH. A	PH. B	PH. C	CCT. NO.	BKR	DESIGNATION
30KVA TRANSFORMER	40	1				2	15	CU-1
		3				4		
		5				6		
AHU-1	20	7				8	15	CU-2
		9				10		
		11				12		
AHU-2	20	13				14	15	CU-3
		15				16		
		17				18		
AHU-3	40	19				20	15	CU-4
		21				22		
		23				24		
AHU-4	40	25				26	20	CU-5
		27				28		
		29				30		
AHU-5	40	31				32	15	CU-6
		33				34		
		35				36		
AHU-6	40	37				38	20	CU-7
		39				40		
		41				42		
AHU-7	15	43				44	15	CU-8
		45				46		
		47				48		
FC-1	15	49				50	15	H-3
		51				52		
		53				54		
SPACE	-	55				56	15	H-4
		57				58		
		59				60		
SPACE	-	61				62	15	H-5
		63				64		
		65				66		
SPACE	-	67				68	15	H-6
		69				70		
		71				72		

PANEL 2MECH1 (225AMP, 120/208VAC, 42 CIRCUIT)

DESIGNATION	BKR	CCT. NO.	PH. A	PH. B	PH. C	CCT. NO.	BKR	DESIGNATION
SPACE		1				2	15	SPARE
SPACE		3				4	15	SPARE
SPACE		5				6	15	SPARE
SPACE		7				8	20	H-1
SPACE		9				10	20	H-2
SPACE		11				12	15	EXISTING FIRE ALARM AIR COMPRESSOR
SPACE		13				14	15	EXISTING VAULT CONDENSING UNIT
SPACE		15				16		
SPACE		17				18	15	EXISTING P-4 PREP AREA
SPACE		19				20	20	EXISTING DIRTY PREP. HEATER
SPACE		21				22		
SPACE		23				24	40	EXISTING CAR CHARGER
SPACE		25				26		
SPACE		27				28	15	SPARE
SPACE		29				30	15	SPARE
SPACE		31				32	20	ROOF RECEPTACLE
SPACE		33				34	20	ROOF RECEPTACLE
SPACE		35				36		SPACE
SPACE		37				38		SPACE
SPACE		39				40		SPACE
SPACE		41				42		SPACE

3 PANEL SCHEDULES
NTS

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CALGARY | VANCOUVER | VICTORIA
Designing A Better Tomorrow

SHEET TITLE
MECHANICAL SCHEDULE, PANEL SCHEDULES AND SINGLE LINE DIAGRAM

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