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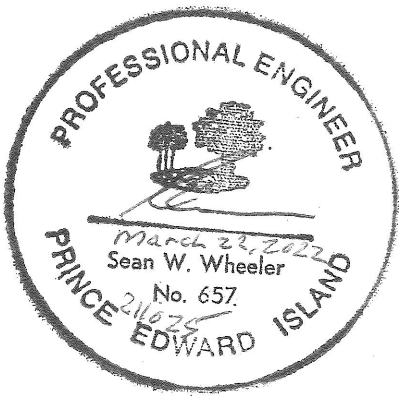
EMERGENCY DEPARTMENT & SHORT STAY UNIT
CHARLOTTETOWN, PE

SPECIFICATIONS

Volume 2 of 5: Division 21 to Division 33



#211025 / IFT / Mar 22, 2022

Prime Consultant:
Coles Associates Ltd.
In association with Parkin Architects Ltd.

Project #: 211025 **Issued for Tender – March 22, 2022**

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TABLE OF CONTENTS

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1 General

1.1 ARCHITECTURAL DETAIL BOOK (VOLUME 3 OF 5)

.1 AD000 - Table of Contents
.2 AD001 - Code Analysis
.3 AD010 - Material / Finishes Schedule Exterior
.4 AD020 - Room Finish Schedule Notes & Abbreviations
.5 AD021 - Room Finish Schedule
.6 AD022 - Room Finish Schedule
.7 AD023 - Room Finish Schedule
.8 AD024 - Room Finish Schedule
.9 AD030 - Door Schedule Notes & Abbreviations
.10 AD031 - Door Schedule
.11 AD032 - Door Schedule
.12 AD033 - Door Schedule
.13 AD034 - Screen Schedule
.14 AD040 - Door Types
.15 AD050 - Door Frame Types
.16 AD051 - Door Frame Types
.17 AD055 - Screen Frame Types
.18 AD060 - Door Frame Details
.19 AD065 - Screen Frame Details - 1
.20 AD066 - Screen Frame Details - 2
.21 AD070 - Accessory Schedule
.22 AD071 - Accessory Schedule
.23 AD072 - Accessory Schedule
.24 AD073 - Accessory Schedule
.25 AD074 - Accessory Schedule
.26 AD075 - Accessory Schedule
.27 AD090 - Assembly Schedules
.28 AD091 - Assembly Schedules
.29 AD095 - Interior Partition Types
.30 AD096 - Interior Partition Types
.31 AD100 - Connection Detail @ Existing Wall (GL-1a & GL-U) and Adjacent Window Infill
.32 AD101 - Typical Column Wrap @ Exterior Wall
.33 AD102 - Typical Column Enclosures
.34 AD103 - Typical Window Infill @ Existing Exterior Wall GL-18 & GL-5a
.35 AD104 - Column Wrap @ GL 4a-Ba
.36 AD105 - Column Wrap @ GL 5a-Ba
.37 AD106 - Column Wrap @ GL 5a-AA
.38 AD107 - Column Wrap @ GL 1a-AA
.39 AD108 - Door Jamb @ Door 5645
.40 AD109 - Typical Window Jamb Detail
.41 AD300 - Roof Connection Detail @ Existing Parapet (GL-U)
.42 AD301 - Slab Connection Detail @ Unit Entrance
.43 AD302 - Connection Detail @ Existing Parapet (GL-60)
.44 AD303 - Slab Connection Detail @ Existing Wall (GL-60)
.45 AD304 - Slab Connection Detail @ GL-U
.46 AD305 - Roof Connection Detail @ Existing Wall (GL-2a-5a)
.47 AD306 - Typical Parapet Cap Detail
.48 AD307 - Parapet Detail @ GL-1a
.49 AD308 - Base of Wall Detail @ GL-1a
.50 AD309 - Window Base Detail @ W-1 & W-3

.51 AD310 - Roof Connection Detail @ Exist GL-21
.52 AD311 - Slab Connection Detail @ GL-4a
.53 AD312 - Floor Construction @ GL-Ba
.54 AD313 - Truss Enclosure @ GL-1a
.55 AD314 - Section Detail at Bulkhead for Anti-Ligature TV Enclosure
.56 AD315 - Door Head @ Door 5645
.57 AD316 - Door Sill @ Door 5645
.58 AD317 - Typical Window Head Detail
.59 AD318 - Typical Window Sill Detail
.60 AD319 - Typical Section Through Column Base
.61 AD320 - Typical Cross Bracing Wrap @ Level 100
.62 AD321 - Shaft Wall Bulkhead @ Door 5600
.63 AD350 - Typical Railings
.64 AD360 - Typical Wall Protection
.65 AD365 - Corner Guard Types
.66 AD366 - Typical Corner Guard, Railings and Sheet Wall Protection at Corners
.67 AD400 - Hand Hygiene Sinks

END OF SECTION

1 General

1.1 LIST OF DRAWINGS

A000 - COVER SHEET FOR VOLUME 4 OF 5

.1 ***Civil Drawings:***
- .1 C100 – Existing Site Plan
- .2 C101 – New Site Plan
- .3 C102 - Details

.2 ***Structural Drawings:***
- .1 S001 - Foundation Plan
- .2 S002 - Level 200 Framing Plan
- .3 S003 - Roof Framing Plan
- .4 S004 - Elevations & Sections
- .5 S005 - Sections
- .6 S006 - Sections
- .7 S007 - Sections, Details & Notes
- .8 S008 - Sections
- .9 S009 - Sections
- .10 S010 - Sections & Details
- .11 S011 - Truss Details

.3 ***Architectural Drawings:***
- .1 A001 - Context Plan & Project Info
- .2 A002 - Sequencing Plans
- .3 A003 - Sequencing Plans
- .4 A010 - Typical Mounting Heights
- .5 A030 - 3D Views
- .6 A040 - Code Plans & Sections
- .7 A050 - Demolition Floor Plan - Level 100
- .8 A051 - Demolition Floor Plan - Level 200
- .9 A100 - Renovated Floor Plan - Level 100
- .10 A101 - Renovated Floor Plan - Level 200
- .11 A102 - Roof Plan
- .12 A142 - Wall Finishes Plan - Level 200
- .13 A152 - Wall Material Plan - Level 200
- .14 A160 - Reflected Ceiling Plan - Level 200 Demo
- .15 A161 - Reflected Ceiling Plan - Level 100 Reno
- .16 A162 - Reflected Ceiling Plan - Level 200 Reno
- .17 A200 - Exterior Elevations
- .18 A300 - Building Sections
- .19 A301 - Building Sections
- .20 A350 - Wall Sections
- .21 A351 - Wall Sections
- .22 A352 - Wall Sections
- .23 A500 - Blow-Up Plans and Interior Elevations
- .24 A501 - Blow-Up Plans and Interior Elevations
- .25 A502 - Blow-Up Plans and Interior Elevations
- .26 A503 - Blow-Up Plans and Interior Elevations
- .27 A504 - Blow-Up Plans and Interior Elevations
- .28 A505 - Blow-Up Plans and Interior Elevations
- .29 A506 - Blow-Up Plans and Interior Elevations

.30 A510 - WR Blow-Up Plans and Interior Elevations
.31 A600 - Millwork Details
.32 A605 - Full Height Cabinets and Stainless Steel Millwork Details
.33 A902 - Furniture & Equipment Plan - Level 200

A000.1 - COVER SHEET FOR VOLUME 5 OF 5

.4 ***Mechanical Drawings:***
- .1 M100 – Level 100 Plumbing – Domestic Water, Sanitary & Storm
- .2 M101 – Level 120 Plumbing – Sanitary & Storm
- .3 M102 – Roof Level – Storm
- .4 M110 – Level 200 Plumbing – Domestic Water
- .5 M120 – Plumbing Details
- .6 M121 – Plumbing & Sanitary Fire Stopping Details
- .7 M200 – Level 200 Heating
- .8 M201 – Level 200 Heating – In-Floor
- .9 M202 – Level 200 Heating – Sensors & Controls
- .10 M210 – Heating & Cooling Details
- .11 M300 – Level 100 Ventilation
- .12 M301 – Level 200 Ventilation – Supply Air
- .13 M302 – Level 200 Ventilation – Return Air
- .14 M303 – Penthouse & Roof Plan
- .15 M304 – Ventilation Sections
- .16 M305 – Level 100 – Existing Ventilation Modification
- .17 M310 – Ventilation Details
- .18 M311 – Ventilation Details
- .19 M400 – Level 100 Sprinkler
- .20 M401 – Level 200 Sprinkler
- .21 M410 – Fire Protection Details
- .22 M500 – Control Details

.5 ***Electrical Drawings***
- .1 DE01 - Demolition Plan Level 100 Power & Systems
- .2 DE02 - Demolition Plan Level 100 - Lighting
- .3 DE03 - Demolition Plan Level 200 - Power & Systems
- .4 DE04 - Demolition Plan Level 200 - Lighting
- .5 E100 - Level 100 & 200 Key Plans - Electrical Routing & Legend
- .6 E200 - Renovated Floor Plan - Level 100 Power, Communications & Systems
- .7 E300 - Renovated Floor Plan Level 200 - Power
- .8 E301 - Penthouse
- .9 E400 - Renovated Floor Plan Level 200 - Communications
- .10 E500 - Renovated Floor Plan Level 200 - Systems
- .11 E600 - Renovated Floor Plan Level 100 - Lighting
- .12 E601 - Renovated Floor Plan Level 200 - Lighting
- .13 E700 - Access Control Details
- .14 E701 - Electrical Details
- .15 E702 - Electrical Details
- .16 E703 - Electrical Details

END OF SECTION

1 General

1.1 APPENDICES

.1 ***APPENDIX 'A'***
Subsurface Investigation Report
Issued by Jacques Whitford, dated January 14, 2008.

.2 ***APPENDIX 'B'***
Government of Prince Edward Island
Structured Cabling Standards, dated February 26, 2016

.3 ***APPENDIX 'C'***
Preliminary Commissioning Plan
Prepared by Maritech Commissioning Works, dated March 2022

Note: ***Appendices are located at the back of Specifications Volume #1 of 2.***

END OF SECTION

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1 General

1.1 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.
.2 Shop drawings; submit drawings stamped and signed by Contractor as reviewed.
.3 Shop drawings to show:
  .1 Mounting arrangements.
  .2 Operating and maintenance clearances.
.4 Shop drawings and product data accompanied by:
  .1 Detailed drawings of bases, supports, and anchor bolts.
  .2 Acoustical sound power data, where applicable.
  .3 Points of operation on performance curves.
  .4 Manufacturer to certify current model production.
  .5 Certification of compliance to applicable codes.
.5 In addition to transmittal letter referred to in Division 01 - General Requirements: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
.6 Closeout Submittals:
  .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 - General Requirements.
  .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
  .3 Operation data to include:
    .1 Control schematics for systems including environmental controls.
    .2 Description of systems and their controls.
    .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    .4 Operation instruction for systems and component.
    .5 Description of actions to be taken in event of equipment failure.
    .6 Valves schedule and flow diagram.
    .7 Colour coding chart.
  .4 Maintenance data to include:
    .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    .2 Data to include schedules of tasks, frequency, tools required and task time.
  .5 Performance data to include:
    .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    .2 Equipment performance verification test results.
    .3 Special performance data as specified.
  .6 Approvals:
    .1 Submit 2 copies of draft Operation and Maintenance Manual to Consultant for approval 4 weeks prior to Substantial Completion. Submission of individual data will not be accepted unless directed by Consultant.
    .2 Make changes as required and re-submit as directed by Consultant.
  .7 Additional data:
    .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  .8 Site records:
    .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
.3 Use different colour waterproof ink for each service.
.4 Make available for reference purposes and inspection.

.9 As-built drawings:
.1 Prior to start of testing, finalize production of as-built drawings.
.2 Identify each drawing in lower right hand corner in letters at least 12 mm (1/2 inch) high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
.3 Submit to Consultant for approval and make corrections as directed.
.4 Perform testing, adjusting and balancing using as-built drawings.
.5 Submit completed electronic and reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 - General Requirements.
.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.3 MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 - General Requirements as follows:
.1 One glass for each gauge glass.
.2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
.3 One trap per ten (10) trap used each size.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 - General Requirements.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

1.5 DEFICIENCY LIST

.1 Lists of work deficiencies will be issued at any time. Rectify immediately work to satisfaction of Consultant.
.2 Submit requests for takeover inspection in writing.

1.6 SITE SERVICES

.1 Known Services:
.1 Drawings indicate known existing facilities.
.2 Locate all known services prior to initiating work.
.3 Consult with and follow Engineer's written instructions before commencing work.
.4 Once location has been set out, assume responsibility for all damage during installation. Bear cost of repairs and replacements made necessary.

.2 Unknown Services:
.1 Locate all services whose exact location is not known.
.2 Avoid damaging or displacing existing services where exact position is not known. Should any damage occur, advise Engineer in writing for remedial instructions.

1.7 CO-ORDINATION

.1 Contractors are to note that space is limited and close coordination of the Work of all Trades is required. Before fabrication or installation begins, the Contractor must do the following:
- .1 The General Contractor is responsible for leading the interference coordination meeting. The Division 23 Ventilation Contractor is to provide an individual with sufficient experience to manage the coordination of work with all other Trades.
- .2 The Division 23 Contractor is responsible for coordinating with all other Mechanical and Electrical Trade Contractors, to minimize conflicts and poor placement of installed equipment and material; and is responsible for providing active input and coordination with all other Trades.
- .3 Extra costs associated with having to redo or relocate services due to non-participation in or non-conformance with "Interdisciplinary Coordination" process by Division 23 Ventilation Contractor, shall be by Division 23 Ventilation Contractor.
- .4 The interdisciplinary coordination process is to be collectively managed by the General Contractor and all the Mechanical and Electrical Contractors with only limited technical support by the Consultant. The Consultant's role will be limited to answering Requests for Information (RFI) and providing review of any coordination sketches prepared by the Mechanical and Electrical Contractors. Additionally the General Contractor's role will be that of providing review, overview and direction.
- .5 The Mechanical and Electrical systems are to be coordinated and work with the available space above the ceiling plane.

.2 The order of precedence in congested area's shall be:
- .1 Drainage piping;
- .2 Trunk ducts;
- .3 Sprinkler mains;
- .4 Heating mains;
- .5 Main conduits;
- .6 Water piping mains;
- .7 Branch ducts, piping and conduits.

.3 The location of equipment / outlets shall be in accordance with the Architects reflected ceiling plan. If an outlet is not shown there or is in conflict with work of another Trade, obtain direction from the Consultant before proceeding.

.4 Relocation of branch ducts, pipes or outlets within 3m of location shown on drawings to facilitate coordination with other Trades, shall not be considered extra work.

.5 Locate distribution systems, equipment and materials to provide minimum interference and maximum usable space.

.6 Where interference occurs, Consultant shall approve location of equipment and materials regardless of installation sequence.

1.8 REGULATIONS

.1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and these specifications and plans. Practices contained in these standards or standards suggested or recommended by referenced organizations, are to be taken as minimum requirements.

.2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

1.9 DRAWINGS

.1 Drawings:
- .1 Are not intended to show structural details or architectural features.
- .2 Are not to be scaled.
- .3 Except where dimensioned, the drawings indicate general mechanical layouts only.

.2 Provide field drawings to indicate relative position of various services when required by Consultant. Obtain Consultant's approval before commencing work.
.3 As-Built (Record) Drawings:
.1 Maintain as specified in Division 01 - General Requirements.

1.10 EQUIPMENT LIST

.1 Submit list of manufacturers named within seven (7) days after award of the contract. Do not order equipment until list is approved.

1.11 ENERGY CONSUMPTION

.1 Consultant may reject equipment submitted for approval on basis of performance or energy consumed or demanded.

1.12 APPROVAL OF EQUIPMENT

.1 When equipment list has been reviewed by Consultant, conform to Division 01 - General Requirements for items shown on equipment list and all other materials and equipment necessary to complete requirements of mechanical systems. This includes equipment named under Standard of Acceptance.

1.13 BREAKDOWN OF COSTS

.1 Price will be broken down at tender time as required by depository instructions.
.2 Immediately upon notice of contract award, further break down tender price to the following minimum requirements:
.1 Sprinkler;
.2 Controls;
.3 Underground Plumbing;
.4 Aboveground Plumbing;
.5 Plumbing Equipment;
.6 Heating;
.7 Heating Equipment;
.8 Ventilation;
.9 Ventilation Equipment.

1.14 APPROVED EQUALS

.1 Submission for an Approved Equal is to contain literature and descriptive information with full specification data. Where the requested item is contained on a printed document with other items, it is to be clearly identified.
.2 The Consultant will not search catalogs, e-mails or websites or contact suppliers to obtain the necessary information for proper evaluation.
.3 Submission by Bidders for evaluation of products requested to be considered as equal must be submitted to Consultant no less than 5 working days prior to closing of tenders. No consideration will be given to approving equals after the close of tenders, except when the specified product is found to have been discontinued by the manufacturer.
.4 The consideration of a product(s) for Approved Equal status and the acceptance of individual products as approved equals is entirely at the discretion of the Consultant.
.5 When products are given Approved Equal status these products may, at the discretion of bidders, be carried in their tender price, provided that ALL costs related to changes to the contract work required to incorporate the Approved Equal product are included in the tender price.
.6 The acceptance of a product by the Consultant as an "Approved Equal," even where not specifically indicated on the Approved Equals listing in the Addendum, is to be understood as being contingent upon the provision of the particular series, model and/or type, complete with all options to meet the specified requirements of the Acceptable Material product.

.7 Products given approved status that are found, during construction period, to not have all specified options available, or do not fit in the the available space, or to have discontinued production of same, or to have made other design changes since the time of approval, will not be accepted for use on this project, except when financial compensation has been mutually agreed upon between the Contractor and the Owner and deemed acceptable by the Consultant. Compensation will not be paid to the Contractor for products acknowledged by the Consultant to be superior to the specified products.

.8 The Contractor is cautioned that all layouts on the Mechanical drawings are based on the specified equipment. Any changes necessary, using acceptable materials will be done at the Contractor's expense. Furthermore, if it is found that the provisions made regarding space conditions are not met, the right is reserved by the Consultant to require installation of the equipment used on the layout.

1.15 PACKAGED EQUIPMENT

.1 The Contractor shall note that whenever package equipment is specified, it is intended that this equipment shall be a complete package with all necessary accessories to allow for fail safe automatic operation.

.2 These accessories shall include all necessary starters, disconnects, relays, transformers, pressure switches, sensors, timers, etc. Where subject to the weather, the device shall be enclosed in a "weatherproof" enclosure.

.3 The Contractor shall be responsible for checking with the supplier of the equipment to ensure that the package equipment is complete with all necessary accessories. The Contractor shall also determine which accessories are factory mounted and which ones are shipped loose with the equipment. The Contractor shall include in his tender an amount for all necessary wiring and piping etc., required to incorporate loose pieces of equipment into the job at no additional cost to the Owner.

.4 The Contractor shall note that the above refers to all package equipment, including boilers, chillers, heat reclaim units, pump sets, condensing units, humidifiers, etc. It shall be his responsibility to ensure the supply and installation of any accessories necessary for the operation of this equipment.

1.16 AS INDICATED

.1 Means that the item or items specified are shown or noted on the drawings.

1.17 EQUIPMENT REQUIREMENTS & INSTALLATION

.1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping without interference from building structure or other equipment.

.2 Space for servicing, disassembly and removal of equipment and components to be provided as recommended by Manufacturer or as indicated.

.3 Equipment drains to be piped to hub or funnel floor drain.

.4 Provide accessible means for lubricating equipment including permanent lubricated "lifetime" bearings.

.5 Mount base mounted equipment on chamfered edge housekeeping pads a minimum of 100mm (1") high and 50mm (2") larger than equipment dimension all around. Pads provided by this Contractor. Co-ordinate sizes with equipment provider.

.6 Pipe drain lines to drains in a manner to avoid disruption of surrounding space.

.7 Line-up equipment, rectangular cleanouts and similar items parallel or perpendicular to building walls wherever possible.

.8 Contractor to provide metal caps and counter flashing for all roof penetrations provided under this section. Installation by this Contractor. This Contractor responsible for all membrane flashing.

1.18 RESPONSIBILITY FOR TEMPORARY TRIAL USAGE

.1 Protect work against damage or loss until accepted by the Consultant.
.2 Obtain written permission to start and test permanent equipment and systems prior to acceptance by Consultant.
.3 Consultant may use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for testing.
.4 See Division 01 - General Requirements for temporary usage. Guarantee period and commencement date shall not be affected.
.5 Clean and renew equipment and system used prior to acceptance. Restore to original, new and full working condition.

1.19 ANCHOR BOLTS & TEMPLATES

.1 Supplied and installed by Division 21, 22, 23 and 25, as indicated and recommended by the Manufacturer.

1.20 PROTECTION OF OPENINGS

.1 Protect equipment, system openings including rough-in plumbing from dirt, dust and other foreign materials with materials compatible to the system.

1.21 ELECTRICAL

.1 Electrical work to conform to Division 26 - Electrical, including the following:
  .1 Supplier and installer responsibility is indicated in the motor, controls and equipment supply schedules on the Electrical drawings and related Mechanical responsibility is indicated on Mechanical Equipment Schedule on the Mechanical drawings.
  .2 Controls wiring and conduit is specified by Division 26 - Electrical, except for conduit, wiring and connections below 50V which are related to Controls systems specified in Division 25 - Integrated Automation. Refer to Division 26 - Electrical for quality of materials and workmanship.

1.22 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Electric equipment shall bear CSA label.
.2 Conform to requirements of Canadian Electrical Code, Local Provincial and Municipal Authorities and specified standards.
.3 Division 21, 22, 23 and 25 responsible for their respective conduit, wiring and connections below 50 V which are related to control systems specified in Divisions 21, 22, 21 and 25 and shown on mechanical drawings. Refer to Electrical section for quality of materials and workmanship for wiring and conduit.
.4 Motors.
  .1 Provide motors for mechanical equipment.
  .2 If delivery of specified motor will delay delivery or installation of any equipment, install a motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
.5 Motors under 372 W: Speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 115V or 208V, unless otherwise specified.
.6 Motors 372 W and larger: EEMAC Class B, squirrel cage induction, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, three phase, 208V in building, unless otherwise specified.
.7 Provide motors, low voltage 50 V and less, wiring from transformers, and temperature pressure, humidity control devices.
.8 Furnish composite wiring diagrams with remote interlocks for control systems, including performance and sequence of operation description of mechanical systems. Submit for approval by Consultant.

.9 Where motors may be subjected to high moisture levels, such as in boiler room, in the air stream after the cooling coil, in areas subjected to washdown or exposed outdoors, the motors are to be splash-proof or totally enclosed fan cooled.

.10 All equipment shall be supplied complete with a disconnect switch. Where exposed to the weather, "weatherproof" disconnects shall be provided. Disconnect switches serving explosion proof motors, shall be explosion proof.

1.23 GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2mm thick sheet metal top and bottoms.
- .3 38mm diameter holes on both shaft centers for insertion of tachometer.
- .4 Removable for servicing.

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

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

.5 Guard for flexible coupling:

- .1 "U" shaped, minimum 1.6mm thick galvanized mild steel.
- .2 Securely fastened in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets.

- .1 Wire or expanded metal screen, galvanized 19mm mesh.
- .2 Net free are of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

1.24 SLEEVES

.1 Provide pipe sleeves at points where pipes pass through masonry or concrete walls or floors.

.2 The Division 21, 22, 23 & 25 Contractor(s) is financially responsible for all core drilling and sleeves required for their works to pass through floor slabs, foundations and block walls. Coordinate all works with General Contractor and all other Divisions. All core drilling to be performed by a qualified Contractor.

.3 Provide acoustical pipe penetration seals where pipes pass through equipment room walls or floors.

- .1 Seals to consist of two bolted pipe halves with minimum 19mm neoprene sponge bonded to inner face.
- .2 Seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping.
- .3 Use cast iron or steel pipe sleeves with annular fin continuously welded at midpoint:
  - .1 Through foundation walls.
  - .2 Where sleeve extends above finished floor.
- .4 Sizes:
  - .1 Provide 6mm (1/4") clearance all around, between sleeve and pipes or between sleeve and insulation.
  - .2 Where piping passes below footings, provide minimum clearance of 50mm (2") between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing.
- .5 Terminate sleeves flush with surface of concrete and masonry and 50mm above floors in mechanical or fan rooms or rooms susceptible to leaks. Not applicable to concrete floors on grade.
- .6 Unless otherwise indicated for pipes passing through roofs, use Thaler Industries model MEF-34 or MEF-44 aluminum mechanical flashings, height 300mm (12"). Anchor flashings in roof construction. Install in accordance with manufacturer's instructions. Make water tight durable joint.

.7 Fill voids around pipes. Remove plastic sleeves.
- .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof pre-retardant non-hardening mastic or manufactured seals equal to "link-seal".
- .2 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe and sleeve with waterproof fire retardant non-hardening mastic. Seal space at each end of sleeve with non-shrinking pipe sealing mastic.
- .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
- .4 Fill future-use sleeves with lime plaster.
- .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M.
- .6 Installation to be continuous through walls and floors.

.8 Temporarily plug all openings during construction.

1.25 ESCUTCHEONS AND PLATES

.1 Provide on pipes and ductwork passing through finished walls, partitions, floors and ceilings.

.2 Use chrome or nickel plated brass, solid type, with set screws for ceiling or wall mounting. Use cast iron type in equipment room. Where split escutcheons are used, they shall be installed to provide continuous appearance.

.3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.

.4 Where sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

.5 Secure to pipe or finished surface but not insulation.

1.26 TESTS

.1 Provide the following supplementary requirements to tests specified:
- .1 Give written 24 hours notice of date when tests will be made.
- .2 Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.
- .3 Conduct tests in presence of Engineer.
- .4 Bear costs including retesting and making good.
- .5 Pipe pressure:
  - .1 Hydraulically test all water supply and steam supply systems at 1 1/2 times system operating pressure or minimum 860 kPa.
  - .2 Maintain test pressures without loss for 4 hours unless otherwise specified.
  - .3 Test drainage, waste and vent piping to code.
  - .4 Prior to test isolate all equipment or other parts which are incomplete or not designed to withstand test pressures.
  - .5 All piping of the drainage and venting systems shall be tested by means of filling the system with water after all outlets have been plugged. All joints shall be checked and the water level must hold without dropping for a period of one hour before the work is to be backfilled or otherwise built-in. Sections of the system may be tested separately provided they are at least 3000mm (120") high and include at least 1500mm (60") of the section below, where applicable. Any leaks observed must be corrected by additional caulking of joints or if necessary by removal of any section of pipe required.
  - .6 Testing shall be done before pipe covering is installed. Leaks must be located, corrected and test reapplied before acceptance of building.
  - .7 Provide test certification for all tests signed by Engineer or designated representative.

1.27 PAINTING

.1 Apply at least one (1) coat of corrosion resistant primer and two (2) coats of suitable industrial corrosion resistant paint to un-insulated piping, hangers, stands, supports, and equipment fabricated from ferrous metals.

.2 Prime and touch up marred finished paintwork to match original.

1.28 ACCESS DOORS

.1 This section to supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings. Provide ULC rated doors in fire rated construction. Installation by General Contractor.

.2 Access doors shall be flush mounted with integral drywall bead, sized 600 x 600 mm (24" x 24") for body entry 300 x 300 mm (12" x 12") for hand entry, or as noted on the drawings. Doors shall open 180 degrees have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Steel shall be prime coated. Doors shall be of approved manufacturer with published literature.

.3 Provide stainless steel access doors for tiled, marble or terrazzo surfaces or special surfaces, including all surfaces in the pool area.

.4 Provide cam type locking device with hand or key lock when located in public corridors and washrooms complete with master keys.

.5 Acceptable material: Williams #WB-DW, Acudor #DW-5040, MIFAB #MDW.

.6 Access hatches shall be kept to a minimum in secure areas. Where access hatches are required, they shall be medium security rated, constructed from 12 gauge material, provided with a continuous concealed piano hinge and cylinder lock with master key. All fasteners to be tamper resistant.

.1 Secure areas shall be all washrooms, short stay rooms, examination rooms, assessment / interview rooms, safe rooms, recliner area and kitchentte.

.7 Standard of acceptance:

.1 Acudor MS-700 or equal.

1.29 DIELECTRIC COUPLINGS

.1 Provide wherever pipes of dissimilar metals are jointed.

.2 Provide insulating unions for pipe sizes NPS 2 and under and insulating flanges for pipe sizes over NPS 2 (DN 50).

.3 Cast brass adapters may be used where approved by Engineer.

.4 Provide felt or rubber gaskets to prevent dissimilar metals contact.

1.30 DRAIN VALVES

.1 Minimum NPS 19mm (3/4") unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap and chain.

.2 Locate at all low points and section isolating valves unless otherwise specified.

.3 Acceptable material: Dahl.

1.31 INSTRUCTION OF OPERATING STAFF

.1 Provide certified personnel to instruct operating staff on operation of mechanical equipment. Provide maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.

.2 Provide instruction during regular work hours prior to acceptance and turn-over to operating staff for regular operation.

.3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn one manual over to Owner and the balance to Engineer.

.4 This Contractor to ensure mechanical systems are complete and fully operational as per the requirements of these documents and the applicable codes. Premature failure of any mechanical system(s) and/or related accessories deemed to be the result of poor workmanship shall be the financial responsibility of the Contractor responsible.

1.32 CLEANING AND FINAL ADJUSTMENT

.1 Clean interior and exterior of all systems including strainers.
.2 Clean and refurbish all equipment and leave in first class operating condition including replacement of all filters in all piping systems.
.3 Balance and adjust all systems and each piece of equipment to operate efficiently.

1.33 EXCAVATION, TRENCHING AND BACKFILLING

.1 All excavation, trenching, granular base or bedding and backfilling, both inside and outside the building, required for the work of Division 22 shall be the financial responsibility of, and carried out by the General Contractor under the direction of the Division 21, 22, 23 or 26 Sub-contractor.
    .1 This work includes the breaking out of existing concrete where new lines are installed below existing concrete floors.
    .2 This work includes housekeeping pads and concrete curbs.

1.34 CUTTING & PATCHING

.1 All cutting and patching required to properly accommodate the work of this Division shall be the financial responsibility of respective Division 21, 22 or 23 and carried out by trades to the applicable Specifications provided in this document.

1.35 FIRESTOPPING AND SMOKE SEALS

.1 All firestopping and smoke seals required to properly accommodate the work of this Division shall be the responsibility of the General Contractor under Specification Section 07 84 00 - Firestopping. Divisions 21, 22, 23 and 25 shall coordinate work with General Contractor.
.2 Work must be performed by a company with experience in the application of firestopping and smoke seals to ULC requirements.
.3 Material shall provide a fire rate equal to that of the separation which has been separated.
.4 Refer to the Architectural drawings for the location and rating of all fire walls.
.5 Submit material shop drawings and all ULC listed installation details for all penetrations applicable to project.
.6 Acceptable material:
    .1 Dow Corning Fire Stop System.
    .2 3M Fire Barrier Penetration.
    .3 Sealing System.
    .4 Bio-Fire Biotherm or Bio-K10 (supplied by Wormald).
    .5 Hilti.

1.36 CONCRETE

.1 All concrete work, both inside and outside the building, required specifically for the work of this Division shall be the financial responsibility of and carried out by the General Contractor under the direction of the Division 21, 22, 23 or 25 Sub-Contractor(s).
    .1 This work includes all housekeeping pads and concrete curbs.

1.37 WASTE MANAGEMENT AND DISPOSAL

.1 Collect and separate waste material and place in on site bin in accordance with Waste Management Plan.

1.38 EXPOSED FASTENERS

.1 Contractor shall minimize exposed fasteners within secure area. Where fastners are required, they shall be a tamper resistant type.

2 Products

2.1 NOT APPLICABLE

.1 Not applicable.

3 Execution

3.1 REPAIRS/ RESTORATION

.1 To Section 09 91 00 - Painting.
.2 Prime and touch up marred finished paintwork to match original.
.3 Restore to new condition, finishes which have been damaged extensively for priming and touch-up.

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  .1 Pressure test.
.2 Manufacturer's Field Services:
  .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

.1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
.3 Where specified elsewhere in Division 21, 22, 23 or 25 manufacturers to provide demonstrations and instructions.
.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
.5 Instruction duration time requirements as specified in appropriate sections.
.6 Consultant will record these demonstrations on video tape for future reference.

3.5 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results.
.2 Section 21 12 01 - Stand Pipe and Hose Assemble
.3 Section 21 13 16 - Dry Pipe Sprinkler Systems
.4 Section 23 05 01 - Installation of Pipe Work
.5 Section 23 05 21 - Thermometer and Pressure Gauges Piping Systems
.6 Section 28 31 00 - Fire Detection and Alarm
.7 Section 33 11 16 - Incoming Site Water Utility Distribution Piping

1.2 REFERENCE STANDARDS

.1 Conform to the following except where specified elsewhere:
  .1 National Building Code of Canada.
  .2 NFPA 13 - Installation of Sprinkler Systems.
  .3 NFPA 24 - Installation of Private Fire Services Mains and their Appurtenances
  .4 NFPA 25 - Inspection, Testing and Maintenance of Water Based Fire Protection Systems.
  .5 NFPA 14 - Installation of Standpipe and Hose Systems.

1.3 SHOP DRAWINGS

.1 Submit shop drawings & calculations in accordance with Division 01 - General Requirements, working plans on computerized CADD file using AutoCAD and design requirements. Drawing standards to be the same as project drawings.
.2 Shop drawings to be submitted for preliminary review prior to submitting to approving authorities.
.3 Submit the following for hydraulically designed systems:
  .1 Ceiling construction.
  .2 Full height cross section of building.
  .3 Location of fire walls/separations.
  .4 Location and size of blind spaces and closets and any questionable small enclosure in which sprinklers are to be installed.
  .5 Make, type, description, and orifice size of sprinklers.
  .6 Temperature rating and location of high temperature sprinklers.
  .7 Number of sprinklers on each riser and on each system by floors and total area protected by each system on each floor.
  .8 Cutting lengths of pipe or centre to centre dimensions.
  .9 Crosses, riser nipples, and sizes.
  .10 Type of hangers, inserts, and sleeves.
  .11 All control and check valves, drain and test pipes, pressure, supervisory and flow switches.
  .12 Provision for flushing connections.
  .13 Name and address of contractor.
  .14 Make, type, model, and size of wet alarm check valve, excess pressure pump.
  .15 Type and location of alarm bells.
  .16 When plans include underground pipe: weight or class, size and material of pipe; type of valves, and valve pits; depth to top of pipe from grade.
  .17 Hydraulic reference points designated by letters or numbers to correspond to the comparable reference points shown in the hydraulic calculation sheets.
  .18 System design criteria, i.e., minimum rate of water application density, design area of water application.
  .19 Actual calculated requirements, i.e., total quantity of water and pressure required at a common reference point for each system.

.20 Elevation data, relative elevation of sprinkler junction points and supply or reference points.
.21 Hydraulic calculations to be submitted on computer printout, including summary sheet, detailed work sheets and graph sheet.

.4 Summary sheet to contain:
.1 Date.
.2 Location.
.3 Name of department or agency.
.4 Building number or other identification.
.5 Description of hazard.
.6 Name and address of contractor or designer.
.7 Name of approving agency/ authority.
.8 System design requirements, including design area of water application, minimum rate of water application density and area per sprinkler.
.9 Total water requirements.

.5 Computer printout sheets to contain:
.1 Sheet number.
.2 Sprinkler description and discharge constant K.
.3 Hydraulic reference points.
.4 Flow in L/S.
.5 Pipe size.
.6 Pipe lengths, centre to centre of fittings.
.7 Equivalent pipe lengths for fittings and devices.
.8 Friction loss in kPa per 30 metre of pipe.
.9 Total friction loss between reference points.
.10 Total friction loss between reference points.
.11 Required pressure in kPa at each reference point.
.12 Velocity pressure and normal pressure if included in calculations.
.13 Notes to indicate starting points, reference to other sheets, or to clarify data shown.

1.4 SAMPLES

.1 Submit samples in accordance with Division 01 - General Requirements.
.2 Submit sample of each type of head proposed for use on this project.

1.5 GENERAL REQUIREMENTS

.1 Work covered by this Section to include installation of new wet sprinkler system, all materials, labour, equipment, working plans, field testing for building and services necessary for or incidental to the design, supply, installation and completion of wet pipe automatic sprinkler system. Work to be coordinated with construction schedule. All bidders are responsible for determining exact site requirements and the extent of work required to maintain fire protection in accordance with NFPA 13 - Installation of Sprinkler Systems.

.2 Quality Assurances: Execute work of this Section by skilled tradesmen only, employed by qualified Fire Protection Contractor in the province regularly engaged in the installation of automatic sprinkler systems and other fire protection equipment.

.3 Systems to include:
.1 Modifications and additions to the existing wet system as required to suit the revised floor plans and construction to meet the requirements of NFPA 13 - Installation of Sprinkler Systems.
.2 Auxiliary drain connections as required.
.3 Sprinkler types as noted.
.4 Water supply connections complete as indicated on drawings.

.4 Prior to submitting shop drawings to Consultant for preliminary review, Contractor shall point out any discrepancies between Engineer's working drawings and architectural reflected ceiling plans as to ceiling elevations, bulkheads, etc., so that these discrepancies can be addressed and rectified prior to commencing any work and to avoid unnecessary conflicts on-site.

1.6 ENGINEERING DESIGN CRITERIA

.1 Design modifications to the existing automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area. Occupancy hazard shall be as required by NFPA 13.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.6 Location of Sprinkler Heads:
- .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.
- .2 Uniformly space sprinklers on branch.

.7 Water Distribution:
- .1 Make distribution uniform throughout the area in which sprinkler heads will open.
- .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density required in NFPA 13.

.8 Density of Application of Water:
- .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
- .2 Application to horizontal surfaces below sprinklers shall be as required for NFPA 13.

.9 Sprinkler Discharge Area:
- .1 Area: hydraulically most remote m2 area as defined in NFPA 13.

.10 Outside Hose Allowances:
- .1 Include allowance in hydraulic calculations of outside hose streams per NFPA.

.11 Friction Losses:
- .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

.12 Water Supply:
- .1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for basis of design in accordance with ANSI/NFPA 13.

.13 Show the following in the drawings submitted to the Owner's Representative for approval.
- .1 Show the layout and size of all piping and equipment from the point of connection to the water supply, to the sprinkler cross mains. The contract drawings must include a detailed sprinkler riser diagram. Water velocity in the piping should not exceed 6 m/s (20 ft/s).
- .2 Show location and size of service mains, interior feed mains, control valves, sprinkler risers, drain lines, sectional valves and inspector's test valves and switches on the drawings.
- .3 Specify waterflow data including hydrant flow results, including location where the hydrant flow test was conducted, the location and size of existing mains and new water supply lines that will serve the sprinkler system (including all supervisory valves), and the location and size of all risers.

.4 Highlight or clearly indicate the area(s) to be protected by sprinklers on the drawings.
.5 Specify waterflow requirements including the design density, design area, the hose stream demand (including location of the hose stream demand), the duration of supply, and sprinkler spacing and area of coverage in this section.
.6 Show the location of the backflow preventer (including provisions for a drain and access for maintenance) where the potable water supply system is at risk of contamination by the sprinkler system on the drawings.
.7 Show all provisions necessary for forward flow testing of the backflow preventer at system demand, as required by NFPA 13 on the drawings. Indicate location of all components and required items, including test ports, for pressure measurements both upstream and downstream of the backflow preventer, a drain to the building exterior, and appropriate permanent means of disposing of the large quantity of water that will be involved in the initial test and subsequent annual test.
.8 Highlight all concealed spaces on the drawings that require sprinkler protection, such as spaces above suspended ceilings, attics, etc. that are built of combustible material or that can contain combustible materials, such as storage, and communication cabling that is not fire-rated.
.9 Provide details on the drawings of pipe restraints for underground piping. This includes details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

1.7 OPERATIONS

.1 For Systems: indicate on building central fire alarm system panel.

1.8 DESCRIPTION OF SYSTEM(S)

.1 Wet pipe system to include:
.1 Wet alarm check valve c/w trim package.
.2 OS&Y controlling gate or butterfly valves.
.3 Water motor gong and galvanized piping and fittings.
.4 Excess pressure pump.
.5 Water pressure gauges as required and indicated on drawings.
.6 Pipe and fittings.
.7 Shut-off valves and drain connections.
.8 Hangers.
.9 Floor and ceiling chrome escutcheon plates.
.10 Water flow, pressure, and supervisory switches.
.11 Floor zone sectional control assemblies as indicated and detailed on drawings.
.12 Inspector's test connections and valves as indicated on drawings for systems.
.13 100 mm (4") interior electric bell operated by systems.
.14 All wiring to building central fire alarm system panel by Division 16. All devices by this contractor.
.15 Sprinkler coverage shall be provided to all areas of the building. Contractor shall make his own assessment of requirements for all areas shown or not shown with sprinkler coverage and shall provide coverage to NFPA-13 or the tender documents, whichever is more stringent. All costs to be included in the contract price.

1.9 CERTIFICATES

.1 Provide written certificate that components are compatible, and where applicable, certified for intended use in accordance with requirements of approving authorities.

1.10 MAINTENANCE DATA

.1 Provide maintenance data in English and French for sprinkler equipment for incorporation into operation and maintenance manual specified in Section 01 78 00 - Closeout Submittals.

1.11 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Provide spare sprinklers in accordance with NFPA 13 latest edition and these specifications.

2 Products

2.1 PIPE AND FITTINGS

.1 Steel Pipe: to NFPA 13, Schedule 10; screwed, welded, flanged roll Schedule 10 or Schedule 40 groove couplings.
.2 Fittings: 1206 kPa (175 osi)minimum working pressure, to conform to the following:
  .1 Cast Iron: screwed to ANSI B16.4, flanged to ANSI B16.1, Class 125 and 250.
  .2 Malleable Iron: screwed to ANSI B16.3, Class 150 and 300.
  .3 Mechanical groove - malleable iron to ASTM A-47, ductile iron to ASTM A-536.
    .1 Coatings - rust inhibiting lead-free paint (standard colour orange).
    .2 Gaskets - elastomeric to ASTM D-2000.
    .3 Bolts and nuts - carbon steel to ASTM A-183 minimum 68.95 Mpa (10,000 psi) tensile strength.
    .4 Acceptable Material:
      .1 Anvil Star
      .2 Victaulic Firelock
  .4 Wrought light steel factory-made, butt weld fittings to ANSI B16.9.
    .1 Butt welding ends for pipe, valves, flanges and fittings to ANSI B16.25.
    .2 Steel pipe flanges and flange fittings to ANSI B16.5.
    .3 Flange bolts: square or hex head bolts with heavy hex nuts to ASTM A307 Class B.
    .4 Flange gaskets: 1.6mm (1/16") thick plain or cloth inserted red rubber to ASTM B16.20 or B16.21.
    .5 Forged steel fittings, socket welded and threaded to ANSI B16.11.
    .6 Wrought copper and bronze solder joint pressure fittings to ANSI B16.22.
    .7 Cast bronze solder joint pressure fittings and ANSI B16.18.
  .5 Wrought light steel factory-made, butt weld fittings to ANSI B16.9.
    .1 Butt welding ends for pipe, valves, flanges, and fittings to ANSI B16.25.
    .2 Steel pipe flanges and flange fittings to ANSI B16.5.
    .3 Flange Bolts: square or hex head bolts with heavy hex nuts to ASTM A307 Class B.
    .4 Flange Gaskets: 1.6mm thick plain or cloth inserted red rubber to ASTM B16.20 or B16.21.
.3 Reducers: One piece fittings, hex face bushings acceptable only where one piece standard reducing fittings of required size are not available.

2.2 VALVES

.1 Valves shall be ULC listed and FM approved, designed for 1205 kPa (175 psi) minimum working pressure (water) and of one manufacturer wherever possible throughout this section.
  .1 Rising stems, to be repackable under pressure and with malleable iron wheel handles.
  .2 Sprinkler valves where required and indicated on drawings, to be equipped with contacts and devices necessary for operation of supervisory system specified under Division 28.
.2 Gate Valves:
  .1 NPS 2 (DN 50) and under: Screwed bronze body and trim to ASTM B61 solid wedge, rising stem. Ball valves are acceptable as alternate.
  .2 NPS 2 (DN 50) and over: Iron body, bronze mounted, OS&Y solid wedge, flanged or roll grooved ends or butterfly gear operated (up to NPS 6).

.3 Globe Valves:
  .1 NPS 2 (DN 50) and under: Bronze body and trim to ASTM B61 (screwed), replaceable composition disc. Ball valves are acceptable as alternate.
.4 Check Valves:
  .1 NPS 2 (DN 50) and under: Bronze swing type to ASTM B61, composition disc (screwed).
  .2 NPS 2 (DN 50) and over: Iron body, bronze mounted, regrind/renew bronze disc and seat ring, flanged or roll grooved. Wafer check type are acceptable alternate.
.5 Drain Valves:
  .1 Angle or globe for 1206 kPa (175 psi) cold water or 362 kPa (52.5 psi) saturated steam.
.6 Wet Alarm Check Valve:
  .1 Flanged/grooved or flanged/ flanged valve, c/w trim package; water motor gong, excess pressure pump and pressure alarm switch.

2.3 SUPERVISORY AND ALARM SWITCHES

.1 Supervisory Switches:
  .1 ULC listed and FM approved, cast aluminum housing with red enamel finish, tamper proof.
  .2 Cord type plug in supervisory devices are not acceptable.
  .3 Acceptable Materials:
    .1 For gate valves:
      .1 Potter OSYSU-2
      .2 System Sensor OSY2
    .2 For butterfly valves:
      .1 Potter PCVS-2
      .2 System Sensor PIBU2
.2 Alarm Switches:
  .1 ULC listed and FM approved, cast aluminum housing with red enamel finish, tamper proof.
  .2 Acceptable Materials:
    .1 For water flow:
      .1 Potter Model VSR-F Series (NPS 2 to NPS 8 pipe / DN 50 to DN 200)
      .2 System Sensor WFD Series
      .3 Potter Model VSR-SF (NPS 1 to NPS 1-1/2 pipe / DN 25 to DN 40)
      .4 System Sensor WFDTA
    .2 For pressure:
      .1 Potter Model PS Series
      .2 System Sensor EPS Series

2.4 PIPE HANGERS

.1 Pipe hangers to be ULC listed for fire protection service, in accordance with NFPA 13 and Section 21 05 01 - Common Results - Mechanical.

2.5 SPRINKLER HEADS

.1 General: to NFPA 13, ULC listed and FM approved for fire service.
.2 Sprinkler heads shall be Quick response frangible bulb type.
.3 Temperature ratings of sprinkler heads to be as per NFPA 13.
.4 Provide minimum 1/2" nominal diameter discharge orifice.

.5 All sprinklers in finished areas, areas with ceilings, shall have chrome finish unless otherwise noted on drawings or in specifications. Sprinklers in unfinished storage areas, arenas and mechanical rooms shall be bronze finish unless otherwise indicated. Security heads shall be used in patient rooms, shower & bathing rooms and corridors, along with locations where ceiling heights is under 3200mm (10'-6").

.6 All sprinklers shall be quick response unless otherwise indicated.

.7 Acceptable material:

.1 Products listed are the standard of acceptance, listed products of other automatic sprinkler manufacturers are considered acceptable provided they are equal to the specified product in every significant respect.

.1 Pendant, Quick Response (non-security) - Reliable Model F1Fr, 1/2" recessed, ordinary temperature 155°F.

.2 Upright, Quick Response (non-security) - Reliable Model F1Fr, 1/2" ordinary temperature 155°F.

.3 Security Pendant, Quick Response - Tyco Raven 5.6K, 13mm, ordinary temperature 74°F, white painted finish.

2.6 SIGNS

.1 Signs for control drain and test valves to NFPA 13.

2.7 SLEEVES AND ESCUTCHEON PLATES

.1 Provide sleeves and escutcheon plates for sprinkler piping systems.

2.8 SPARE PARTS

.1 Provide metal red enameled sheet steel cabinet with locking device containing six (6) spare sprinklers of each type and melting point temperature; 4 keys for emergency repair work; sprinkler wrench.

.2 Install cabinet in mechanical room near alarm valve.

2.9 FINISHES

.1 Finished Areas: Chromeplated valves and fittings.

.2 All piping, fittings, etc. in areas where there is no suspended ceiling to be painted by Division 09.

2.10 FIRE DEPARTMENT CONNECTION

.1 Provide connection approximately 1.5m (60") above finished grade, location as indicated.

.2 To ANSI/NFPA 13 and ULC 5543 listed, siamese type.

.3 Polished bronze chrome plated recessed or exposed of approved two way type with plug, chain and identifying fire department connection escutcheon plate.

.4 Thread Specifications: Compatible with local fire department.

2.11 ESCUTCHEON PLATES

.1 Provide on piece or split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished stainless steel plates chromium-plated finish on copper alloy plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.12 INSPECTOR'S TEST CONNECTION

.1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m (120 feet) above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.

.2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.13 SIGNS

.1 Attach properly lettered English and approved metal signs to each valve and alarm device to ANSI/NFPA 13.
.2 Permanently fix hydraulic design data nameplates to riser of each system.

2.14 SPARE PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

3 Execution

3.1 INSPECTION

.1 Piping, accessories, etc., not to be recessed, painted, or concealed before it has been inspected and approved.

3.2 INSTALLATION

.1 Install horizontal valves with stems in vertical upright position where spaces allow.
.2 Provide additional pipe hangers to allow for expansion and contraction in sprinkler system.
.3 In areas with suspended ceilings, allow ample clearance between sprinkler piping in ceiling spaces and top of light fixtures for relocation of fixtures under future renovations.
.4 Where applicable, sprinkler heads installed in suspended tile ceilings to be centered in tiles where possible, or a minimum of 150mm (6") from any edge of tile. This section shall be responsible for coordinating the location and layout of the sprinkler system and sprinkler heads with Division 26 and other related sections of Division 22, 23 or 25.
.5 Provide chromeplated valves, nozzles, fittings, except in unfinished areas where satin brass finish is acceptable.
.6 Provide pressure gauges at each water supply connection and at highest point of sprinkler riser, complete with 6mm (1/4") gauge connection and gauge cock.
.7 Exposed piping passing through floors, ceilings and walls shall be supplied with chromeplated escutcheon plates, unless otherwise approved by Consultant.
.8 Coordinate locations of all holes required for pipes and otherwise meet specified requirements of Section 21 05 01 Common Work Results - Mechanical for sleeves and pipes.
.9 Allow for extra sprinkler heads in Mechanical Rooms, for air handling equipment and large ducts, and in areas where large ducts may be located exposed under ceilings, to maintain adequate coverage.
.10 Provide OS & Y gate or butterfly control valve at base of each combined sprinkler/standpipe riser, complete with electrical supervisory switch.
.11 Provide NPS 2 (DN 50) nominal drain valve at base of each riser, arranged to drain to safe location.
.12 All pendent sprinklers shall be installed on return bends
.13 Provide gate valve in piping, protecting elevator hoistways, machine rooms, and machinery space.
.14 Provide ball or butterfly valves for zone control.
.15 Contractor shall penetrate beams where required. Reinforce beam penetrations with Schedule 40 steel pipe sleeve, sized to accommodate sprinkler pipe. Fully weld sleeve to beam. Submit detail locations to project Structural Engineer for approval prior to execution.
.16 Listed flexible sprinkler hose fittings are permitted.

3.3 PROTECTION OF COMPLETED WORK

.1 Paint exposed steel pipe and fittings, except special finishes.

.2 Provide red plastic coated wire baskets around sprinkler heads in mechanical, electrical, storage, elevator machine and telephone rooms, around ventilation equipment, under stair landings, in service areas, and other areas that may be requested by authorities having jurisdiction, to protect against possible mechanical injury.

3.4 IDENTIFICATION

.1 Place enamelled steel signs in locations as per NFPA 13 and 14 latest edition.

.2 For outdoor signs secure with stainless steel bolts.

3.5 TESTING

.1 Site Test, Inspection:

- .1 Perform test to determine compliance with specified requirements in presence of Owner's Representative.
- .2 Test, inspect, and approve piping before covering or concealing.
- .3 Preliminary Tests:
  - .1 Hydrostatically test each system at 1400 kPa (203 psi) for a 2 hour period with no leakage or reduction in pressure.
  - .2 Flush piping with portable water in accordance with NFPA 13.
  - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
  - .4 Test alarms and other devices.
  - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
- .4 Formal Tests and Inspections:
  - .1 Do not submit request for formal test and inspection until preliminary test and connections are completed and approved.
  - .2 Submit written request for formal inspection at least fifteen (15) working days prior to inspection date.
  - .3 Repeat required test as directed.
  - .4 Correct defects and make additional tests until systems comply with contract requirements.
  - .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
  - .6 Authority of Jurisdiction, will witness formal test and approve systems before they are accepted.

.2 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

.3 Site Tests:

- .1 Field test each fire pump, driver and controllers in accordance with ANSI/NFPA 20. Testing shall include:
  - .1 Verification of proper installation, system initiation, adjustment and fine tuning.
  - .2 Verification of the sequence of operations and alarm systems.
- .2 Testing to be witnessed by authority having jurisdiction.

.3 Develop, with Owner's Representative assistance, detailed instruction for O & M of this installation.

3.6 SYSTEM(S) FLUSHING

.1 Where applicable ensure that sprinkler system and pressure tanks have been flushed thoroughly before making final connections and putting system into operation.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 21 12 01 - Standpipe and Hose Assembly
.2 Section 21 13 13 - Sprinkler System
.3 Section 23 05 01 - Installation of Pipework
.4 Section 23 05 21 - Thermometers and Pressure Gauges - Piping Systems
.5 Section 28 31 00 - Fire Detection and Alarm
.6 Section 33 11 16 - Incoming Site Water Utility Distribution Piping

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  .1 ANSI/NFPA13, Standard for the Installation of Sprinkler Systems.
  .2 ANSI/NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).
.3 Underwriter's Laboratories of Canada (ULC)
  .1 CAN/ULC S543, Internal Lug Quick Connect Coupling for Fire Hose.

1.3 SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements.
    .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.
.2 Shop Drawings:
  .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements and in accordance with ANSI/NFPA 13.
    .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Provinces of Prince Edward Island, Canada.
.3 Samples:
  .1 Submit samples in accordance with Division 01 - General Requirements.
  .2 Submit samples of following:
    .1 Each type of sprinkler head.
    .2 Signs and valve tags.
.4 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
  .1 Test reports:
    .1 Submit certified test reports for packaged fire pumps from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
    .2 Test each pump/driver package at factory to provide detailed performance data and to demonstrate compliance with ANSI/NFPA and specification. Submit certified test curves for approval of Consultant.
    .3 Test hydrostatically to meet requirements of fire protection system to which it will be connected.
  .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  .3 Instructions: submit manufacturer's installation instructions.
  .4 Manufacturer's Field Reports: manufacturer's field reports specified.

.5 Closeout Submittals:
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Provide detailed hydraulic calculations including: summary sheet, for aboveground and underground piping, as well as other deliverables for incorporation into manual specified in Division 01 - General Requirements, in accordance with ANSI/NFPA 13.

1.4 QUALITY ASSURANCE

.1 Qualifications:
- .1 Installer: company or person specializing in packaged fire pump installations with documented experience.

.2 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 ENGINEERING DESIGN CRITERIA

.1 Design system in accordance with ANSI/NFPA 13, using following parameters:
- .1 Hazard:
  - .1 To suit occupancy as indicated.
- .2 Pipe size and layout:
  - .1 Hydraulic design.
  - .2 Sprinkler head layout: to ANSI/NFPA 13 or as directed by authority having jurisdiction.
- .3 Water supply:
  - .1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with ANSI/NFPA 13.
- .4 Zoning:
  - .1 System zoning as indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Division 01 - General Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

1.7 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Division 01 - General Requirements.
- .2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

2 Products

2.1 PIPE, FITTINGS AND VALVES

.1 Pipe:
- .1 Ferrous Galvanized: to ANSI/NFPA 13. Schedule 10 or 40 roll grooved, schedule 40 minimum threaded.
- .2 Copper tube: to ANSI/NFPA 13.

.2 Fittings and joints to ANSI/NFPA 13:
- .1 Ferrous: screwed, welded, flanged or roll grooved.

.2 Copper tube: screwed, welded, flanged or roll grooved.
.3 Fittings:
.1 Roll grooved steel pipe:
.1 Branch outlets to be accomplished utilizing Mechanical-T branch connectors with locating collar engaging into hole. Provide Grade 'E' standard pressure-responsive gasket or o-rings for sealing purposes. Branch outlet connection to be either roll-grooved of female threaded to match branch piping.
.2 Sprinkler head connections, branch connections, drop nipples and springs shall be made with hole cute outlet-T with female thread outlet connections with locating collar engaging into hole. Provide Grade 'E' standard pressure responsive gasket.
.3 Pipe fittings such as 90 degree elbow, 45 degree elbow, straight tees, etc., shall be of ductile iron to ASTM A-536 or forged steel to ASTM A-234 with grooved or shouldered ends for direct connection into grooved piping systems with steel pipe.
.4 Stainless steel braided flexible hose with branch line nipples. Size NPS1/2 and 3/4 (DN 15 & DN 20) FM Approved, rated at 1375 kPa (200 psi), light weight, pre-assembled mounting bracket for T-Bar ceiling.
.4 Grooved butterfly valves NPS 2 1/2 to NPS 10 (DN 65 to DN 250).
.1 Ductile iron body to ASTM A-536 coated with a polyphenylene sulphide blend.
.2 Disc of ductile iron to ASTM A-536 with EPDM coating providing bubble tight shut off.
.3 Grooved ends for installation in grooved steel piping system.
.4 Suitable for 2000 kPa (290 psi) working pressure.
.5 Provide complete with two single pole, double throw supervisory switches pre-wired monitoring the open position, in weatherproof housing.
.6 Manual gear operator.
.7 To be utilized in field piping NPS 1 1/2 to NPS 10 (DN 40 to DN 250).
.5 Grooved check valves:
.1 Ductile iron body to ASTM A-536.
.2 Single disc, spring loaded check valve suitable for anti-hammer service.
.3 Provide valve drilled, tapped and plugged downstream for drainage outlet.
.4 Grade 'E' EPDM Deal
.5 Grooved ends for installation in grooved steel piping systems.
.6 Pressure rated up to 1725 kPa (250 PSI).
.6 Valves NPS 1 to NPS 2 DN 25 to DN 50), threaded or grooved.
.1 Ductile iron body to ASTM A-536, painted.
.2 Type 316 stainless steel ball.
.3 Grooved ends for installation in grooved steel piping system.
.4 Suitable for 2400 kPa (350 psi) working pressure.
.5 Provide with double pole, double throw supervisory switch, pre-wired monitoring the open position, in weatherproof housing.
.6 Manual gear operator.

.3 Auxiliary valves:
.1 ULC listed for fire protection service.
.2 Up to NPS 2 (DN 50): bronze, screwed ends, OS & Y gate.
.3 NPS 2 1/2 (DN 65) and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.
.4 Grooved butterfly valves NPS 2 1/2 to NPS 10 (DN 65 to DN 250)
.5 Swing check valves.
.6 Grooved check valves

.7 Ball drip.
.8 Valves NPS 1 to NPS 2 (DN 25 to DN 50), threaded or grooved.
.9 Tamper devices wired back to fire alarm panel.

.4 Pipe hangers:
.1 ULC listed for fire protection services.

2.2 SPRINKLER HEADS

.1 General: to ANSI/NFPA 13 and ULC listed for fire services.

2.3 SPRINKLER HEAD TYPE A

.1 Upright bronze.

2.4 SPRINKLER HEAD TYPE B

.1 Pendant chrome link and lever type.

2.5 SPRINKLER HEAD TYPE C

.1 Pendant chrome glass bulb type.

2.6 SPRINKLER HEAD TYPE D

.1 Recessed polished type with ring and cup.

2.7 SPRINKLER HEAD TYPE E

.1 Flush polished link and lever type.

2.8 SPRINKLER HEAD TYPE F

.1 Side wall polished link and lever type.

2.9 AUXILIARY SUPERVISORY SWITCHES

.1 General: to ANSI/NFPA 13 and ULC listed for fire service.
.2 Valves:
.1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
.3 Flow switch type:
.1 With normally open and normally closed contacts and supervisory capability.
.4 Pressure alarm switch:
.1 With normally open and normally closed contacts and supervisory capability.

2.10 WATER GONG

.1 To ANSI/NFPA 13 and ULC listed for fire service. Location as indicated.

2.11 FIRE DEPARTMENT CONNECTION

.1 To ANSI/NFPA 13 and ULC listed, siamese type, location as indicated. Thread specifications to be compatible with local fire department.
.2 Polished bronze. Threaded metal caps and chains.

2.12 DRY PIPE VALVE

.1 ULC listed.
.2 Cast iron, flanged type, sized to suit water main.
.3 Components:
.1 Accelerator.
.2 Air maintenance device with low pressure alarm.
.3 Alarm pressure switch with supervisory capability.

.4 Pressure gauges.
.5 Drain valve.
.6 Test valve with associated piping.
.7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.

2.13 COMPRESSED AIR SUPPLY

.1 Automatic Air Compressor.
.2 ULC listed.
.3 Capacity:
  .1 To restore normal air pressure in system within 30 minutes.
  .2 To provide air pressure of 140 kPa (20 psi) in excess of calculated trip pressure of dry pipe valve.
.4 Piping: ferrous, NPS 3/4 (DN 20) screwed joints and fittings, to ANSI/NFPA 13.

2.14 PRESSURE GAUGES

.1 ULC listed and to Section 23 05 21 - Thermometers and Pressure Gauges - Piping Systems.
.2 Maximum limit of not less than twice normal working pressure at point where installed.

2.15 RELIEF VALVE

.1 ULC listed.

2.16 SPARE PARTS CABINET

.1 For storage of maintenance materials, spare sprinkler heads and special tools.
.2 Construct to sprinkler head manufacturers standard.

2.17 SWITCHES

.1 OS&Y Valve Supervisory Switches shall be in weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.
.2 Alarm Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. The alarm pressure switch shall be ULC Listed for the application in which it is used. Activation of the alarm pressure switch shall cause an alarm on the fire alarm system control unit.
.3 High/Low Pressure Supervisory Switches: The pressure switch shall be ULC Listed and contain two single pole double throw contacts. Each switch shall be adjustable from 70 to 141 kPa (10 to 60 psi). The low pressure switch shall supervise pressure in the system and shall be set to activate at 70 kPa (10 psi) above the dry-pipe valve trip point pressure. The high pressure switch shall supervise pressure in the system and shall be set to activate at 70 kPa (10 psi) above the normal dry-pipe supervisory pressure. Activation of either high or low pressure switch shall cause a supervisory alarm on the fire alarm on the fire alarm system control unit.

2.18 MANUAL CONTROL STATIONS

.1 Manual Control Stations: ULC listed, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "Manual Control Station" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13 and NFPA 25.
.2 Testing to be witnessed by authority having jurisdiction.
.3 Install water gong as indicated.
.4 Install fire department connections as indicated.
.5 Install spare parts cabinet as indicated.
.6 Pressure gauges:
  .1 Location:
    .1 On water side and air side of dry pipe valve.
    .2 At air receiver.
    .3 In each independent pipe from air supply to dry pipe valve.
    .4 At exhausters and accelerators.
  .2 Install to permit removal.
  .3 Locate so as not subjected to freezing.
.7 Valve identification:
  .1 Identify drain valve, by-pass valves and main shut-off valve and all auxiliary valves.
.8 Drains:
  .1 Provide drips and drains, including low point drains in accordance with NFPA 13.
  .2 Pipe drains to discharge at safe point, outside of the building.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
  .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
.2 Preliminary Testing: Flush newly installed systems prior to performing tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, pneumatically test system, test air compressor fill time to operating in NFPA 13, in the presence of the consultant or their designated representative. For dry-pipe sprinkler systems with a quick-opening device, the system shall be trip tested with the quick-opening device functioning and with the quick-opening device disabled. Record the time to water delivery for each test. Demonstrate pitch of pipe is in compliance with NFPA 13.
.3 Final Inspection and Testing: Subject system to test in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise consultant to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for eat least 10 days prior to the final inspection, with adjustments made to prevent false alarms. Contractor to test and verify system flow, tamper switches, and alarms devices in presence of Owner's Representative and provide written commissioning report. Correct deficiencies and retest system as necessary, prior to the final inspection and testing. Include the operation of all features of the systems under normal operations in test. At the conclusion of final inspection and testing, blow out dry-pipe system piping using compressed air. Verify piping is fully drained, including low point drains.

3.4 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 REFERENCES

.1 NFPA 10, Portable Fire Extinguishers - 2018 Edition.
.2 CAN/ULC-S508-2018, Rating and Fire Testing of Fire Extinguishers.

1.2 SHOP DRAWINGS

.1 Submit shop drawings according to Section 01 33 00 - Submittal Procedures.

2 Products

2.1 EXTINGUISHER

.1 FE-1: 10 lb. Type ABC dry chemical (ammonium phosphate powder) extinguisher with heavy duty mounting bracket.
  .1 Acceptable material: Extinguisher
    .1 Flag ABC -10G min. ULC rating 4-A, 60-B,C (Light & Ordinary hazard)
    .2 Flag ABC -10H min. ULC rating 6-A, 80-B,C (Extra hazard)
.2 FE-2: 10 lb. (4.5 kg) Type ABC dry chemical (ammonium phosphate powder) extinguisher with semi -recessed prime coated 16 ga. steel cabinet.
  .1 Acceptable material: Extinguisher
    .1 Flag ABC -10G min. ULC rating 4-A, 60-B,C (Light & ordinary hazard)
    .2 Flag ABC -10H min. ULC rating 6-A, 80-B,C (Extra hazard)
  .2 Acceptable material: Cabinet
    .1 C.F.H. Industries Model CE-950-1
    .2 Wilson Cousins Model 1E-10C
.3 FE-3: 10 lb. (4.5 kg) Type ABC dry chemical (ammonium phosphate powder) extinguisher with medium security fully recessed prime coated 12 ga. steel cabinet with cylinder lock.
  .1 Acceptable material: Extinguisher
    .1 Flag ABC -10G min. ULC rating 4-A, 60-B,C (Light & ordinary hazard)
    .2 Flag ABC -10H min. ULC rating 6-A, 80-B,C (Extra hazard)
  .2 Acceptable material: Cabinet
    .1 National Fire Equipment Model: CE-950-3-2-MED, Model 151 Cylinder lock, designed for 4" wall.

3 Execution

3.1 INSTALLATION

.1 Install extinguishers securely mounted to walls in locations indicated on drawings.
.2 Fire extinguishers to be installed so that maximum travel distance does not exceed 22 m (72 feet).
.3 Fire extinguishers to be installed 900mm (36") above finished floor.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results - Mechanical.

1.2 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.
.2 Shop drawings; submit drawings stamped and signed by a Contractor as reviewed.
.3 Shop drawings to show:
  .1 Mounting arrangements.
  .2 Operating and maintenance clearances.
.4 Shop drawings and product data accompanied by:
  .1 Detailed drawings of bases, supports, and anchor bolts.
  .2 Acoustical sound power data, where applicable.
  .3 Points of operation on performance curves.
  .4 Manufacturer to certify current model production.
  .5 Certification of compliance to applicable codes.
.5 In addition to transmittal letter referred to in Division 01 - General Requirements: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
.6 Closeout Submittals:
  .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 - General Requirements.
  .2 Operation and maintenance manual approved by, and final copies deposited with, consultant before final inspection.
  .3 Operation data to include:
    .1 Control schematics for systems including environmental controls.
    .2 Description of systems and their controls.
    .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    .4 Operation instruction for systems and component.
    .5 Description of actions to be taken in event of equipment failure.
    .6 Valves schedule and flow diagram.
    .7 Colour coding chart.
  .4 Maintenance data to include:
    .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    .2 Data to include schedules of tasks, frequency, tools required and task time.
  .5 Performance data to include:
    .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    .2 Equipment performance verification test results.
    .3 Special performance data as specified.
    .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  .6 Approvals:
    .1 Submit 2 copies of draft Operation and Maintenance Manual to Owner's Representative for approval 4 weeks prior to Substantial Completion. Submission of individual data will not be accepted unless directed by Consultant.
    .2 Make changes as required and re-submit as directed by Consultant.
  .7 Additional data:
    .1 becomes apparent during specified demonstrations and instructions.
  .8 Site records:

.1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
.3 Use different colour water proof ink for each service.
.4 Make available for reference purposes and inspection.

.9 As-built drawings:
.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
.3 Submit to Owner's Representative for approval and make corrections as directed.
.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 - General Requirements.
.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health, Safety and Emergency Response Procedures.Division 01 - General Requirements.

1.4 MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 - General Requirements as follows:
.1 One set of packing for each pump.
.2 One casing joint gasket for each size pump.
.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 - General Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

2 Products

2.1 MATERIALS

.1 All materials used on this project shall be new and CSA approved unless noted otherwise.

3 Execution

3.1 PAINTING, REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 00 - Painting.
.2 Prime and touch up marred finished paintwork to match original.
.3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  .1 Perform tests as specified in other sections of this specification.

.2 Manufacturer's Field Services:
  .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

.1 Owner's Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Owner's Representative may record these demonstrations on video tape for future reference.

3.5 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system

END OF SECTION

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1 General

1.1 SECTION INCLUDES

.1 Materials and installation for copper domestic water service used in the following:
- .1 Copper incoming domestic water service, up to NPS 2 1/2.
- .2 Hard drawn copper domestic hot and cold water services inside building.

1.2 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results - Mechanical.
.2 Section 23 05 01 - Installation of Pipework.
.3 Section 23 05 22 - Valves - Bronze.
.4 Section 23 05 23 - Valves - Cast Iron.
.5 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.6 Section 23 20 21 - Thermal Insulation for Piping.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
- .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM A536 Standard Specification for Ductile Iron Castings.
- .3 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .4 AST M - Standard Specification for cross linked Polyethylene (PEX) tubing.
- .5 ASTM F877 Standard specification for cross-linked polyethylene (PEX) plastic hot and cold water distribution systems.
- .6 ASTM F 1960 Standard Specification for cold expansion fittings with PEX reinforcing rings for use with cross-linked polyethylene (PEX) tubing.

.3 American Water Works Association (AWWA).
- .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 AWWA 6606 Grooved and Shouldered Joints.

.4 Canadian Standards Association (CSA International).
- .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
- .1 MSS-SP-67, Butterfly Valves.
- .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.7 American National Standards Institute/National Sanitation Foundation (ANSI/NSF).
- .1 ANSI/NSF 61 Drinking Water System Components.
- .2 ANSF/NSF14 Plastic Piping System Components and Related Materials.

1.4 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.

.2 Submit product data for following: piping, fittings, valves and adhesives.
  .1 Provide manufacturers printed product literature and data sheets including product characteristics, performance criteria, physical size, finish and pressure/temperature limitations.
.3 Submit WHMIS MSDS - Material Safety Data Sheets to Consultant for each hazardous material prior to bringing hazardous materials to site.
.4 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.
.5 Grooved joint couplings and fittings to be indicated on product submittals and to be specifically identified with the applicable style or series designation.

1.5 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Separate for reuse and recycling and place in designated containers Steel waste in accordance with Waste Management Plan.
.4 Place materials defined as hazardous or toxic in designated containers.
.5 Handle and dispose of hazardous materials in accordance with CEPA and local or municipal regulations.
.6 Fold up metal banding, flatten and place in designated area for recycling.

1.7 QUALITY ASSURANCE

.1 Press Joint Copper Systems.
  .1 Installer shall be a qualified, licensed within the jurisdiction, and factory trained with the installation of copper press joint systems. Certificate of factory training shall be submitted prior to starting work.
  .2 Copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer.
  .3 The installation of copper tubing for hot and cold water distribution systems shall conform to the requirements of the National Plumbing Code of Canada.

2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.
  .1 Above ground:
    .1 Copper tube, hard drawn, type L: to ASTM B88M.
    .2 PEX tubing to be S102.2 Plenum Rated, and meet 25/50 Smoke and Flame ratings up to 3".
  .2 Buried or embedded:
    .1 Copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
    .2 Cross-linked Polyethylene (PEX), non-air barrier type: to ASTM F 876 and ASTM F 877 with no buried joints.
    .3 Pipe sleeve shall be provided where piping passes through concrete.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
.2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.
.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
.5 NPS 2 and larger: roll grooved to CSA B242. Cast bronze to ANSI/ASME B16.18 or wrought copper to ANSI/ASME B16.22.
  .1 Fittings to be manufactured to copper tube dimensions, flaring of tube or fitting ends to accommodate IPS sized couplings is not permitted.
.6 NPS 1 1/2 and under: Cast copper, ANSI/ASMS B16.12 of wrought copper, ANSI/ASME B16.22 with stainless steel internal components, EPDM seal and push to comment or press fit joints for hand drawn copper tube type L or type K rated for 1300 KPA at ASTM B88
.7 NPS 1½ and under: Cast copper, ANSI/ASME B16.18 or wrought copper, ANSI/ASME B16.22; with 301 stainless steel internal components. EPDM seal and push to connect or press fit joints, hand drawn copper tube type L or K rated for 1300 kPA at ASTM B88.

2.3 JOINTS

.1 Rubber gaskets, latex free, 1.6 mm thick: to AWWA C111.
.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
.3 Solder: 95/5 tin copper alloy lead free.
.4 Teflon tape: for threaded joints.
.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket. Gasket to be classified in accordance with ANSI/NSF 61 for potable water service. Couplings to be manufactured to copper tube dimensions. Flaring of tube or fitting ends to accommodate IPS sized couplings is not permitted.
.6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.
.7 Push to connect: EPDM gasket, UL classified in accordance with ANSI/NSF 61 for potable water service.

2.4 GATE VALVES

.1 NPS 2 and under, soldered:
  .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 22 - Valves - Bronze
.2 NPS 2 and under, screwed:
  .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 22 - Valves - Bronze
.3 NPS 2-1/2 and over, in mechanical rooms, flanged:
  .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23 - Valves - Cast Iron
.4 NPS 2-1/2 and over, other than mechanical rooms, flanged:
  .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23 - Valves - Cast Iron.

2.5 GLOBE VALVES

.1 NPS2 and under, soldered:
  .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 22 - Valves - Bronze
  .2 Lockshield handles: as indicated.
.2 NPS 2 and under, screwed:
  .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 22 - Valves - Bronze
  .2 Lockshield handles: as indicated.

2.6 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 22 - Valves - Bronze.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 22 - Valves - Bronze.

.3 NPS 2-1/2 and over, flanged:

.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind seat, bronze disc, bolted cap specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

2.7 BALL VALVES

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 22 - Valves - Bronze.

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 22 - Valves - Bronze.

.3 NPS 2 (DN 50) and under, ASTM F1960.

.1 Cold Expansion by Pipe Manufacturer with Lead Free Brass body, ball, and stem, working pressure up to 250 PSIG.

2.8 BUTTERFLY VALVES

.1 NPS 2-1/2 and over, wafer or lug:

.1 To MSS-SP-67, Class 200.

.2 As specified in Section 23 05 26 - Butterfly Valves.

.2 NPS 2-1/2 and over, grooved ends:

.1 Class 300, as specified in Section 23 05 26 - Butterfly Valves

3 Execution

3.1 INSTALLATION

.1 Install in accordance with NPC and local authority having jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05 Installation of Pipework.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Grooved joint couplings and fittings to be installed in accordance with the manufacturer's written installation instructions. Grooved ends to be clean and free from indentations, projections and roll marks in the area from pipe end to groove. Gaskets to be verified as suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative to provide on-site training for Contractor's field personnel in the use of grooving tools, application of groove and installation of groove, and installation of grooved joint products. The manufacturer's representative to periodically visit the jobsite and review installation. Contractor to move and replace any joints deemed improperly installed.

.5 Push-to Connect and Press Fit Piping: Prepare copper tube and install in strict accordance with installation instructions. Pipe ends to be cleaned, free from indentations, projections, burrs, and foreign matter. Use a tube preparation tool to clean and make installation mark. Push copper tube into fittings to installation depth mark, per installation instructions. Keep fittings free of dirt and oil.

.6 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.7 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
.8 Install pipe work in accordance with Section 23 05 05 -Installation of Pipework and by certified Journey Person supplemented as specified herein.
.9 Grooved joint couplings and fittings to be installed in accordance with the manufacturer's written installation instructions. Groove ends to be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets to be verified as suitable for the intended service prior to installation. Gaskets to be moulded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative to provide on site training for contractor's field personnel in the use of grooved tools, application of groove and installation of grooved joint products. The manufacturer's representative to periodically visit the job site and review installation. Contractor to remove and replace any joints deemed improperly installed.
.10 Push to connect piping: Prepare copper tube and install in strict accordance with installation instructions. Pipe ends to be cleaned, free from indentations, projections, burns, and foreign matter. Use tube preparation tool to clean and make installation mark. Push copper tube into fittings to installation depth mark, per installation instructions. Keep fittings free of dirt and oil.
.11 Buried Tubing:
  .1 Lay in well completed washed sand in accordance with AWWA Class B bedding.
  .2 Bed tubing without crimping or constriction. Minimized us of fittings.
  .3 Buried fittings shall be approved for direct burial by the manufacturer and not affect the warranty period or benefits.

3.2 VALVES

.1 Isolate equipment, fixtures and branches with butterfly or ball valves.
.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

.1 Conform to requirements of Section 21 05 01 - Common Work Results - Mechanical
.2 Test pressure: greater of 1-½ times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory bacterialogical and chemical testing to verify that system is clean to provincial potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.

3.5 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.
.2 Verify that system can be completely drained.
.3 Ensure that pressure booster systems are operating properly.
.4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Consultant.
.2 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.7 START-UP

.1 Timing: Start up after:
  .1 Pressure tests have been completed.
  .2 Disinfection procedures have been completed.

.3 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

.1 Timing:

.1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize HWS and HWC systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

.1 In accordance with Division 01 - General Requirements, using report forms as specified.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

.3 Chemical and biological water testing report.

.4 Pressure testing report signed off by Contractor and witness for each section of piping tested.

.5 Flushing and cleaning report signed off by Contractor and witness for each section of piping.

END OF SECTION

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM B32, Specification for Solder Metal.
- .2 ASTM B306, Specification for Copper Drainage Tube (DWV).
- .3 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).
- .1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .2 CAN/CSA-B125, Plumbing Fittings.

1.2 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.3 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:
- .1 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, storm and vent Type DWV to: ASTM B306.
- .1 Fittings.
  - .1 Cast brass: to CAN/CSA-B125.
  - .2 Wrought copper: to CAN/CSA-B125.
- .2 Solder: lead free, 95:5 antimonial tin solder, type TA, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary, storm and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating of bitumous.
- .1 Joints.
  - .1 Mechanical joints.
    - .1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
    - .2 Stainless steel clamps.
  - .2 Hub and spigot.
    - .1 Neoprene Gasket to CSA B70.
    - .2 Cold caulking compounds.

.2 Above ground sanitary, storm and vent: to CAN/CSA-B70.
- .1 Joints.
  - .1 Mechanical joints.
    - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

3 Execution

3.1 INSTALLATION

.1 In accordance with Section 23 05 01 - Installation of Pipework and by a Certified Journey Person.
.2 Install in accordance with Canadian Plumbing Code and local authorities having jurisdiction.

3.2 TESTING

.1 Pressure test buried systems before backfilling.
.2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

.1 Cleanouts:
  .1 Ensure accessible and that access doors are correctly located.
  .2 Open, cover with linseed oil and re-seal.
  .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
.2 Test to ensure traps are fully and permanently primed.
.3 Storm water drainage:
  .1 Verify domes are secure.
  .2 Ensure weirs are correctly sized and installed correctly.
  .3 Verify provisions for movement of roof system.
.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).
.6 Provide copies of test reports for maintenance manuals.

END OF SECTION

1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CAN/CSA-B45 Series, Plumbing Fixtures.
- .2 CAN/CSA-B125, Plumbing Fittings.
- .3 CAN/CSA-B651, Barrier-Free Design.

1.2 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets as required.
- .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
  - .1 Indicate, for all fixtures and trim:
    - .1 Dimensions, construction details, roughing-in dimensions.

.3 Closeout Submittals:
- .1 Submit maintenance data in accordance with Division 01 - General Requirements.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

1.3 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Waste Management and Disposal:
- .1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
- .2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

1.5 ACCEPTABLE MATERIAL

.1 Fixtures: American Standard, Kindred, Fiat, AMI Novanni, Elkay, Zurn.

.2 Trim: Delta, Chicago Faucet, Powers, Crane, Sloan, Zurn.

2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: architectural drawings to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

2.2 SINKS

.1 S-1 Single Bowl Sink - Counter Mounted
- .1 Sink:
  - .1 Centres based on trim, 20-1/2" x 20" x 8" (521mm x 508mm x 203mm) deep, counter mounted, back ledge, grade 18-8 type 302 stainless steel, single compartment, satin finished rim and bowl, self rimming, with crumb cup strainer, sound deadening and mounting kit.
  - .2 Acceptable Material: FRANKE LBS6808-1/3.
- .2 Trim:
  - .1 C.P.8" (203mm) C.C., cast brass lead-free body, washerless, 1/4 turn ceramic drip-free disc valve brass cartridges, gooseneck spout with tamper-resistant 8.3 LMP (2.2 GPM) laminar (non-aerating) flow outlet and cast brass 4" (102mm) blade handles. Laminar flor aerator and screws to be vandal resistant.
  - .2 Acceptable Material: Delta 23C674, American Standard, Chicago.
- .3 Supplies:
  - .1 C.P. Polished Brass, rigid horizontal nipples 3/8" (10mm) x 5" (127mm) long, I.P.S. heavy all brass angle stops with wheel handle stops, escutcheons and with flexible copper risers.
  - .2 Acceptable Material: McGuire H165N5
- .4 Trap:
  - .1 C.P. polished cast brass adjustable body, 1-1/2" (38mm) with cleanout plug, seamless brass wall bend and escutcheon.
  - .2 Acceptable Material: McGuire 8912C

.2 S-2 Single Bowl Sink - (Trim and Supplies only)
- .1 Trim:
  - .1 C.P.8" (203mm) C.C., cast brass lead-free body, washerless, 1/4 turn ceramic drip-free disc valve brass cartridges, gooseneck spout with tamper-resistant 8.3 LMP (2.2 GPM) laminar (non-aerating) flow outlet and cast brass 4" (102mm) blade handles.
  - .2 Acceptable Material: Delta 23C674 American Standard, Chicago
- .2 Supplies:
  - .1 C.P. Polished Brass, rigid horizontal nipples 3/8" (10mm) x 5" (127mm) long, I.P.S. heavy all brass angle stops with wheel handle stops, escutcheons and with flexible copper risers.
  - .2 Acceptable Material: McGuire H165N5
- .3 Trap:
  - .1 C.P. polished cast brass adjustable body, 1-1/2" (38mm) with cleanout plug, seamless brass wall bend and escutcheon.
  - .2 Acceptable Material: McGuire 8912C.

.3 JS-1 Mop Sink - Precast Terrazo Floor Mounted - Serviceptor
- .1 Sink:
  - .1 24" x 24" x 12" (610mm x 610mm x 305mm) deep, floor mounted, Precast Terrazzo, with one piece stainless steel cast integral cap on all four sides and Integral Drain with strainer.
  - .2 Acceptable Material: Stern Williams HL-1810 Mop Sink, Acorn Terrazzo-Ware, Fiat.
- .2 Trim:
  - .1 C.P. 8" (203mm) C.C., heavy duty construction, wall mounted, solid cast brass body, cast brass hooded lever handles, body mounted vacuum breaker.
  - .2 Acceptable Material: Chicago 897-CP American Standard Faucet & Fiat.
- .3 Accessories:

.1 S.S Mop Hanger; Mop Sink Drain Gasket; S.S Back Splash Panels (on two sides). Provide separate set of hot and cold water hose bibbs with backflow preventers for Command Centre.
.1 Acceptable Material: Stern Williams, Acorn & Fiat

3 Execution

3.1 INSTALLATION

.1 Mounting heights:
.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
.2 Wall-hung fixtures: as indicated, measured from finished floor.
.3 For barrier-free washroom: to comply with most stringent of either NBCC or CAN/CSA B651.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.
.2 Adjustments:
.1 Adjust water flow rate to design flow rates.
.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
.3 Checks:
.1 Aerators: operation, cleanliness.
.2 Vacuum breakers, backflow preventers: operation under all conditions.
.3 Wash fountains: operation of flow-actuating devices.
.4 Thermostatic controls:
.1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

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1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM).
- .1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA).
- .1 AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.
- .2 AWWA C701, Cold Water Meters-Turbine Type for Customer Service.
- .3 AWWA C702-1, Cold Water Meters-Compound Type.

.3 Canadian Standards Association (CSA International).
- .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
- .2 CSA-B79, Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
- .3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

.5 Plumbing and Drainage Institute (PDI).
- .1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
- .2 PDI-WH201, Water Hammer Arresters Standard.

1.2 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
- .2 Indicate dimensions, construction details and materials for specified items.
- .3 Submit WHMIS MSDS material safety data sheets. Indicate VOC's for adhesive and solvents during application and curing.

.3 Instructions: submit manufacturer's installation instructions.

.4 Manufacturers' Field Reports: manufacturers' field reports specified.

.5 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Division 01 - General Requirements, include:
- .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list.

1.3 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.

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

.3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.

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

2 Products

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to CSA B79.
.2 Type 1: Ligature resistant linear drain with flashing flange, 16 gauge SST with satin finish, V trough drain design with center 2" no-hub outlet.
  .1 Acceptable material: Whitehall WHLD-60-F or equal.
.3 Type 2: Ligature resistant, cast iron, anchor flange, adjustable nickel bronze strainer, secured with vandal proof screws.
  .1 Acceptable material: Whitehall WHFD.

2.2 ROOF DRAINS

.1 Type 1: Standard coated roof drain and overflow drain, with cast iron body 381 mm diameter, with polyethlene dome, under-deck clamp to suit roof construction, flashing clamp ring with integral gravel stop.
  .1 Acceptable material: Zurn Z-165-SC, J.R. Smith, Mifab, Watts.

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with tamper proof brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
  .1 Acceptable Material: Zurn, Z1400, J.R. Smith, Mifab, Watts.
.2 Access Covers:
  .1 Wall Access: face or wall type, stainless steel square or round cover with tamper proof head securing screws, bevelled edge frame complete with anchoring lugs.
    .1 Acceptable material: Zurn ZANB-1460, Mifab, Enpoco, J.R. Smith.
  .2 Floor Access: cast iron body and frame with adjustable secured nickel bronze top and:
    .1 Plugs: bolted bronze with neoprene gasket.
    .2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.
      .1 Acceptable material: Zurn ZN-1400-VP, Mifab, Enpoco, J.R. Smith.

2.4 WATER HAMMER ARRESTORS

.1 Stainless steel or copper construction, bellows or piston type: to PDI-WH201.
  .1 Acceptable Material: Zurn Z-1700, J.R. Smith, Mifab, Precision Plumbing Products.

2.5 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.
  .1 Acceptable Material: Watts 288A, Zurn 35, J.R. Smith, Mifab.

2.6 HOSE BIBBS

.1 Bronze construction complete with integral hose connection vacuum breaker, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
  .1 Acceptable Material: Watts IHB-1, Zurn..

2.7 TRAP SEAL PRIMERS

.1 For single fixtures only: Brass, with integral vacuum breaker, NPS1/2 solder ends, NPS1/2 drip line connection.
  .1 Acceptable material: Precision plumbing products PR-500, Mifab MR-500
.2 Up to four fixtures: Metered water quantity from distribution unit. Locate maximum 3 m from fixture.

.1 Acceptable material: Precision plumbing product, PI-5006/w DV-4, Mifab M2-500 c/w MI-DU

.3 Up to 12 fixtures: Electronic trap priming manifold with:
- .1 Backflow Preventer or Air Gap
- .2 Pre-set 24 hour time clock
- .3 Manual override switch
- .4 120V solenoid valve
- .5 120V or 3-wire connection
- .6 NPS 3/4 inlet connection
- .7 Calibrated manifold
- .8 Water hammer arrestor
- .9 Mounted in steel cabinet
- .10 Compression outlet fittings
- .11 Inlet shutoff valve
- .12 Supplies minimum 59 ml at 138 kPa.
  - .1 Acceptable material: Mifab MI-300

2.8 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS2 and under, bronze body, screwed ends, with brass cap, tapped blow-off connection and plug.

.3 NPS2 1/2 and over, cast iron body, flanged ends, with bolted cap and tapped blow-off connection with bronze ball valve.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada, and.

.2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm above finished grade unless otherwise indicated.

3.5 NON-FREEZE GROUND HYDRANT

.1 Install with top of box flush with ground and with drainage connection to discharge as indicated.

3.6 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.7 BACK FLOW PREVENTORS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code or the Authority Having Jurisdiction.
  .1 Reduced pressure type where backflow would constitute health hazard.
  .2 Double check type where backflow would constitute a nuisance or be aesthetically objectionable or material which would not constitute a health hazard.
.2 Pipe discharge to terminate over nearest drain and/or service sink.

3.8 BACKWATER VALVES

.1 Install in main sewer lines, where indicated.
.2 Install in access pit as indicated.

3.9 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.10 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.
.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.
.3 Install PEX piping to floor drain or fixture.

3.11 STRAINERS

.1 Install with sufficient room to remove basket.

3.12 START-UP

.1 General:
  .1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
.2 Timing: start-up only after:
  .1 Pressure tests have been completed.
  .2 Disinfection procedures have been completed.
  .3 Certificate of static completion has been issued.
  .4 Water treatment systems operational.
.3 Provide continuous supervision during start-up.

3.13 TESTING AND ADJUSTING

.1 General:
  .1 In accordance with Section 01 91 13 - General Commissioning Requirements : General Requirements, supplemented as specified.
.2 Timing:
  .1 After start-up deficiencies rectified.
  .2 After certificate of completion has been issued by authority having jurisdiction.
.3 Application tolerances:
  .1 Pressure at fixtures: +/- 70kPa.
  .2 Flow rate at fixtures: +/- 20%.
.4 Adjustments:
  .1 Verify that flow rate and pressure meet design criteria.
  .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
.5 Floor drains:
  .1 Verify operation of trap seal primer.
  .2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.
.4 Check security, accessibility, removeability of strainer.
.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:
.1 Test tightness, accessibility for O&M of cover and of valve.
.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
.3 Verify visibility of discharge from open ports.

.7 Roof drains:
.1 Check location at low points in roof.
.2 Check security, removeability of dome.
.3 Adjust weirs to suit actual roof slopes, meet requirements of design.
.4 Clean out sumps.
.5 Verify provisions for movement of roof systems.

.8 Access doors:
.1 Verify size and location relative to items to be accessed.

.9 Cleanouts:
.1 Verify covers are gas-tight, secure, yet readily removable.

.10 Water hammer arrestors:
.1 Verify proper installation of correct type of water hammer arrester.

.11 Strainers:
.1 Clean out repeatedly until clear.
.2 Verify accessibility of cleanout plug and basket.
.3 Verify that cleanout plug does not leak.

.12 Hose bibbs, sediment faucets:
.1 Verify operation at all low points.

.13 Commissioning Reports:
.1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, supplemented as specified.

.14 Training:
.1 In accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.
.2 Demonstrate full compliance with Design Criteria.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section includes:
- .1 The supply and installation of washroom fixtures and trim.

.2 Products installed but not supplied under this Section:
- .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
- .2 Equipment installed by others:
  - .1 Connect with unions.
- .3 Equipment not installed:
  - .1 Capped for future connection by others.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CAN/CSA-B45 Series-02, Plumbing Fixtures.
- .2 CAN/CSA-B125-01, Plumbing Fittings.
- .3 CSA Standards\CSA-B561-04, Barrier-Free Design.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.

.3 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

.4 Indicate fixtures and trim:
- .1 Dimensions, construction details, roughing-in dimensions.
- .2 Factory-set water consumption per flush at recommended pressure.
- .3 For water closets, urinals: minimum pressure required for flushing.

.5 Closeout Submittals:
- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Division 01 - General Requirements.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:
- .1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
- .2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

1.6 ACCEPTABLE MATERIAL

.1 Fixtures: American Standard, AMI Novanni, Eljer, Toto, Kindred, Caroma, Kohler, Zurn.

.2 Trim: Delta, Chicago Faucets, Powers, Crane, Sloan, Zurn.

2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
.3 Exposed plumbing brass to be chrome plated.
.4 Number, locations: architectural drawings to govern.
.5 Fixtures in any one location to be product of one manufacturer and of same type.

2.2 MENTAL HEALTH PLUMBING FIXTURES

.1 All fixtures shall utilize an anti-ligature design specifically intended for the safety of mental health patients and fitting for patient rooms. All Stainless Steel fixtures shall be white powder-coated.
.2 There shall be no sharp edges/corners, exposed piping or conduit in patient areas. The faucet should be a single unit with a round handle that is designed with a taper or a round lever so a noose would slip off with the weight of a person. A sensor type faucet is preferable since this has no lever.
.3 Tamper resistant screws/security fasteners shall be used. Tamper resistant strainers and screws used for the covers should be of the TORX or Allen head type for maintenance access purposes. Coordinate with the Owner for type of tamper resistant screws they are currently using.
.4 Each patient toilet room shall have individual isolation valves on hot and cold water lines accessible above ceilings.
.5 Fixtures:
  .1 Water Closet;
  .2 Lavatory;
  .3 Shower push button controls for the shower are also an acceptable alternative.
.6 Trim in any one location to be product of one manufacturer and of same type.

2.3 WATER CLOSETS

.1 WC-1 (Barrier-Free): Wall-mounted, exposed flush valve, top spud ultra-low flush, maximum 6 litres/flush.
  .1 Bowl:
    .1 Wall hung for flush valve, vitreous china with EverCleanTM antimicrobial surface which inhibits the growth of stain and odor causing bacteria, mold and mildew, elongated siphon jet flush action bowl, 2-1/8" (54mm) fully glazed internal trapway, 10" x 12" (254mm x 305mm) large water surface, 6L (1.6 gal) per flush, 1-1/2" (38mm) top spud with condensate channel. Top of seat shall be mounted 17 inches above finished floor level.
    .2 Acceptable material:
      .1 American Standard 3351.160 AFWALL Elongated, Kohler or Approved Equal.
  .2 Flush Valve:
    .1 Quiet, Exposed, Diaphragm Type, Chrome Plated Closet Flushometer for either left or right hand supply with the following features:
      .1 PERMEX™ Synthetic Rubber Diaphragm.
      .2 ADA Compliant Battery Powered infrared Sensor for automatic "No Hands" operation.
      .3 Infrared Sensor with Multiple-focused, Lobular Sensing Fields for high and low target detection.
      .4 Latching Solenoid Operator.
      .5 Engineered Metal Cover with replaceable Lens Window.

.6 User friendly three (3) second Flush Delay.
.7 Courtesy Flush™ Override Button.
.8 Four (4) Size AA Batteries factory installed.
.9 "Low Battery" Flashing LED.
.10 Infrared Sensor Range Adjustment Screw.
.11 Initial Set-up Range Indicator Light (first 10 minutes).
.12 Chrome Plated Metal Handle Cap.
.13 1" I.P.S. Screwdriver Bak-Chek® Angle Stop.
.14 Free Spinning, Vandal Resistant Stop Cap.
.15 Adjustable Tailpiece.
.16 High Back Pressure Vacuum Breaker Flush Connection with One-piece Bottom Hex Coupling Nut.
.17 Spud Coupling and Flange for 1½" Top Spud.
.18 Sweat Solder Adapter with Cover Tube and Cast Set Screw Wall Flange.
.19 High Copper, Low Zinc Brass Castings for Dezincification Resistance.
.20 Fixed Metering Bypass and No External volume Adjustment to ensure Water Conservation.
.21 Diaphragm, Stop Seat and Vacuum Breaker to be molded from
.22 Diaphragm, Stop Seat and Vacuum Breaker to be molded from PERMEX™ Rubber Compound for chloramine resistance.

.2 Acceptable material:
.1 Sloan G2 Optima Plus or Approved Equal.

.3 Seats:
.1 Elongated heavy duty anti-microbial solid plastic open front less cover, with reinforced stainless steel check hinge, posts, washers and nuts.
.2 Acceptable Material: CENTOCO AM500STSCC.

.4 Carrier:
.1 Single vertical / horizontal, 4"(100mm) drain, all duco coated cast iron fittings, rear anchor bolt, face plate, heavy duty legs, adjustable nipple, plated hardware, cap nuts, test plug and protection cap.
.2 Acceptable Material: Jay R. Smith 0210Y, 0230Y, or Approved Equal.

.2 WC-2: Ligature Resistant Water Closet (ADA) Barrier-Free (Floor Mounted, ASME A112.19.3 and CSA B45.4)

.1 Security fixture fabricated from 14 gauge or 16 gauge type 304 stainless steel. The standard toilet shall include: elongated toilet bowl with contoured seat, integral crevice-free self-draining flushing rim with positive after fill and fully enclosed trap which shall maintain a minimum 50 mm (2 inch) seal and pass 54 mm (2-1/8 inch) ball. Skirt of toilet bowl shall be extended to floor as close to front of toilet bowl to prevent tie off. 6 L (1.6 gallons) per flush. Top of seat shall be 432 to 483 mm (17 to 19 inches) above finished floor. Fixture shall withstand loadings up to 2000 lbs. with no measureable deflection and loadings up to 5,000 lbs. with no permanent damage.
.1 Fittings and Accessories: Rear wall chase connections; 102 mm (4 inch) waste on-floor outlet and 40 mm (1-1/2 inch) water back spud. Provide toilet waste extension, gaskets, wall sleeve, and cleanout. Provide water connections with individual shutoff valve for each fixture.
.2 Seat: Seat shall be ABS plastic secured with tamper resistant fasteners and adhesive.

.3 Flush Valve: Mechanical flush valve with push button actuator, water saver design per flush with maximum 10 percent variance, rear spud connection, adjustable tailpiece, 20 mm (1 inch) IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM B584 alloy classification for semi-red brass.

2.4 WASHROOM LAVATORIES:

.1 L-1 : Wall-Hung
- .1 Basin
  - .1 Single Faucet Hole, 21-1/4" x 22" x 5 - 7-1/2" (540mm x 559mm x 127-191mm) deep, wall hung, integral back splash, self draining deck area, no overflow, sloped front lip, vitreous china, for concealed arm carrier. c/w Semi-China Pedestal, to cover exposed piping as per local codes.
  - .2 Acceptable Material:
    - .1 American Standard 0955.000 Murro Sealed Overflow, Kohler, Crane or Approved Equal.
- .2 Basin Drain:
  - .1 C.P., cast brass 1 piece top, open grid less overflow holes and 17 gauge (1.5mm), 32mm (1 1/4") tailpiece.
  - .2 Acceptable Material:
    - .1 McGuire 155A-L0 or equal.
- .3 Trim (Supplied by Others, Installed by this Contractor):
  - .1 Deck mounted single hole faucet, battery operated, polished chrome plated, solid brass internal waterway construction, efficient dual beam infrared sensors, 5 3/8" C-C Rigid/Swing field convertible gooseneck spout, 0.5 GPM (1.9 L/min) vandal resistant Laminar (non-aerating) spray outlet, includes inlet supply check valves, Multiple field adjustable modes and ranges 6 V Lithium CRP2 battery included, low battery indicator, User adjustable temperature control mixer, dual supply for hot and cold water service, above deck hermetically sealed electronics, above deck water- tight solenoid with filter screen, free spinning flexible braided stainless steel supply, hoses with filter screens, mounting hardware included and 4" C-C trim cover plate. Units with separate control box will not be considered.
  - .2 Fixture shall meet the requirements of CSA-Z317.1-2016 - Special Requirements for Plumbing Installations in Health Care Facilities.
  - .3 Acceptable Material:
    - .1 Chicago Hytronic 116.223.21.1-FC.
- .4 Supplies:
  - .1 C.P., polished brass, rigid horizontal nipple 3/8" (9.5mm) x 3" (75mm) long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and S.S. braided flexible risers.
  - .2 Acceptable Material: McGuire H165LKN3.
- .5 Trap:
  - .1 C.P., polished, cast brass adjustable body, 1-1/4" (32mm) with cleanout plug, seamless brass wall bend and escutcheon.
  - .2 Acceptable Material: McGuire 8872C or equal.
- .6 Carrier:
  - .1 With concealed arms and block base feet support with semi-pedestal supported plate.
  - .2 Acceptable Material: Jay R. Smith0700-Z-M.

.2 L-2: Ligature Resistant ADA Barrier-Free Lavatory:
- .1 Dimensions for lavatories are specified, length by width (distance from wall) and depth.

.2 Brass components in contact with water shall contain no more than 0.25 percent lead content by dry weight. Faucet flow rates shall be 1.9 L/m (0.5 gpm).

.3 Ligature Resistant Lavatory, front access barrier free lavatory fabricated from cast polymer densified solid surface material composed of polyester / acrylic resin, UV stabilizer aluminum trihydrate and mineral fillers, corterra or equal. Exposed stainless steel shall have #4 finish or powder coated white, approximately 559 mm by 510 mm (22 inches by 20-1/16 inches) and 127 mm (5 inches) depth. Electronic faucet controlled by infrared sensor, single temperature. Basin shall have side splashes and back splashes, slow drain with air vent, elbow waste 20 mm (1-1/2 inch FIP), sloped backsplash and self-draining soap dish. Punching for faucet on 102 mm (4 inches) centers.

.4 Valve and bubbler conforms with lead free requirements of NSF61.

.5 Faucet: Solid cast brass or cast stainless steel construction, vandal resistant, heavy-duty, electronic controlled by infrared sensor, single temperature, control valve assembly. Provide laminar flow control device, adjustable hot water limit stop, inline thermastatic mixing valve and vandal proof screws. Faucet shall be hard wired to a 120V GFCI circuit.

.6 Drain: Cast or wrought brass with flat, ligature resistant grid strainer offset tailpiece, chrome plated. Pop-up drains are prohibited.

.7 Stops: Angle type.

.8 Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extensions to wall. Exposed stainless steel trap enclosure.

.3 L-3: Infection Prevention Sink:

.1 Basin

.1 Non-porous solid surface polymer resin, single hold faucet, wall mounted, deep internal basin, angled internal slope, thin outside rim, angled downward, offset drain, antimicrobial coating, dome strainer, P-Trap cover, closed elbow and tail piece. Provide Wall Carrier.

.2 Acceptable Material: Whitehall 4150.

.2 Trim (Supplied by Others, Installed by this Contractor):

.1 Deck mounted single hole faucet, battery operated, polished chrome plated, solid brass internal waterway construction, efficient dual beam infrared sensors, 5 3/8" C-C Rigid/Swing field convertible gooseneck spout, 1.5 GPM (5.6 L/min) vandal resistant Laminar (non-aerating) spray outlet, includes inlet supply check valves, Multiple field adjustable modes and ranges 6 V Lithium CRP2 battery included, low battery indicator, User adjustable temperature control mixer, dual supply for hot and cold water service, above deck hermetically sealed electronics, above deck water- tight solenoid with filter screen, free spinning flexible braided stainless steel supply, hoses with filter screens, mounting hardware included and 4" C-C trim cover plate. Units with separate control box will not be considered.

.2 Fixture shall meet the requirements of CSA-Z317.1-2016 - Special Requirements for Plumbing Installations in Health Care Facilities.

.1 Acceptable Material: Chicago Hytronic 116.223.21.1-FC.

.3 Supplies

.1 C.P., polished brass, rigid horizontal nipple 3/8" (9.5mm) x 3" (75mm) long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and S.S. braided flexible risers.

.4 Acceptable Material: McGuire H165LKN3.

.4 L-4 : Wall-hung

.1 Basin

.1 Three (3) hole faucet (8" centers), 20-1/2" x 18-1/4" x 12-1/8" (521mm x 464mm x 308mm) deep, wall hung, integral back splash, self draining deck area, sealed overflow, sloped front lip, vitreous china, for concealed arm carrier.
.2 Acceptable Material:
.1 American Standard 0356.915.020 Lucerne, or approved equal

.2 Basin Drain:
.1 C.P., cast brass 1 piece tops, open grid less overflow holes and 17 gauge (1.5mm), 32mm (1-1/4") tailpiece.
.2 Acceptable material:
.1 McGuire 155A-L0 or equal.

.3 Trim:
.1 Below deck mount three (3) hole faucet with 8" (200mm) centers, two (2) blade handles, chrome plated finish, solid brass internal waterway construction, 6" (152mm) gooseneck spout, 1.5 GPM (5.7 L/min) flow control aerator, dual supply for hot and cold water service.
.2 Acceptable Material:
.1 Delta 27C2944 or approved equal

.4 Supplies:
.1 C.P., poished braass, rigid horizontal nipple 3/8" (9.5mm) x 3" (75mm) long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and S.S. braided flexible risers
.2 Acceptable Material:
.1 McGuire H165LKN3 or equal

.5 Trap:
.1 C.P., polished cast brass adjustable body, 1-1/4" (32mm) with cleanout plug, seamless brass wall bend and escutcheon.
.2 Acceptable Material:
.1 McGuire 8872c or equal

.6 Carrier:
.1 With concealed arms and block base feet support with semi-pedestal supported plate.
.2 Acceptable Material:
.1 Jay R. Smith 0700-Z-M or equal

2.5 SHOWERS

.1 S-1: Barrier Free Shower Ligature Resistant
.1 Shower Bath Mixing Valve (Wall Mounted, Concealed Supplies, Type T/P Combination Valve with ligature resistant single lever handle).
.2 Shower Head Assembly: Metallic institutional shower head with flow control to limit discharge to 5.7 l/m (1.5 gpm). Conical ligature resistant showerhead, chrome plated brass.
.3 Valves: Shower valve shall meet performance requirements of ASSE 1016 lead free Type T/P combination thermostatic and pressure balancing individual showers, with chrome plated metal, ligature resistant single type operating handle adjustable for rough-in variations and chrome plated metal. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 50 degrees C (120 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a maximum of 5.7 l/m (1.5 gpm) at 310 kPa (45 psig) pressure drop.

.4 For barrier-free access fixtures, provide knurled diverter valve handle with hand-held, ligature resistant shower head with hook. Hose and hook shall be on quick disconnect so that when head is removed, hook is also disconnected.

.2 Shower floor drains shall be vandal resistant and as specified in Section 22 42 01 - Plumbing Specialties and Accessories.

3 Execution

3.1 INSTALLATION

.1 Mounting heights:
- .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
- .2 Wall-hung fixtures: as indicated, measured from finished floor.
- .3 For barrier-free washroom: to comply with most stringent of either NBCC or CAN/CSA B651.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:
- .1 Adjust water flow rate to design flow rates.
- .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Adjust flush valves to suit actual site conditions.
- .4 Adjust urinal flush timing mechanisms.
- .5 Automatic flush valves for WC's and urinals: set controls to prevent unnecessary flush cycles during silent hours.

.3 Checks:
- .1 Water closets, urinals: flushing action.
- .2 Aerators: operation, cleanliness.
- .3 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:
- .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes: The supply and installation of showers and bathtubs, along with associated trim.

.2 Products installed but not supplied under this Section:

.1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.

.2 Equipment installed by others.

.1 Connect with unions.

.3 Equipment not installed.

.1 Capped for future connection by others.

1.2 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 61 33 - Hazardous Materials.

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements

.2 Indicate, for all fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

.3 Closeout Submittals:

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in accordance with Division 01 - General Requirements

.2 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.3 QUALITY ASSURANCE

.1 Health and Safety: Do construction occupational health and safety in accordance with Division 01 - General Requirements

1.4 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse in accordance with Division 01 - General Requirements

.2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

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

2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: architectural drawings to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

2.2 EMERGENCY EQUIPMENT

.1 Emergency Eye Wash (EW-1):
- .1 Shower certified to meet ANSI Z358.1.
  - .1 Stainless steel wall mounted eye / face wash shall include a stainless steel 11" round bowl, stainless steel eyewash anti- surge heads and stainless steel face ring, polished stainless steel dust cover, stainless steel in-line 50 x 50 mesh water strainer, eyewash ball valves equipped with stainless steel ball and stem. Unit shall also include universal sign, test kit, self adhesive high visibility safety green and bright yellow stripes,inspection tags and 32mm IPS supply.
  - .2 Acceptable material:
    - .1 Guardian G1891-T.
- .2 Mixing valve:
  - .1 Thermostatic mixing valve that mixes hot and cold water for the tempering of shower units at a maximum flow rate of 40 gpm. Provide with hot, cold, mixed temperature gauges, panel kit recessed steel cabinet, with lockable hinged door.
  - .2 Acceptable material:
    - .1 Lawler 911e Series, CSA B125.3.

2.3 FIXTURE PIPING

.1 Hot and cold water supplies to each fixture.
- .1 Chrome plated flexible metal supply pipes each with quarter-turn angle ball valve stop, chrome plated pipe nipple or copper tube with chrome cover and escutcheon to properly cover all pipe & fittings exposed through the wall.

.2 Waste:
- .1 Brass P trap with cleanout on each fixture not having integral trap.
- .2 Chrome plated in all exposed places.
- .3 Escutcheon to properly cover all exposed pipe & fittings through the wall.

3 Execution

3.1 INSTALLATION

.1 Mounting heights:
- .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
- .2 Physically handicapped: to comply with most stringent of either NBCC or CAN/ CSA B651.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:
- .1 Adjust water flow rate to design flow rates.
- .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:
- .1 Aerators: operation, cleanliness.
- .2 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:
- .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Medical oxygen gas system.
.2 Medical compressed air system.
.3 Medical vacuum system.
.4 Nitrous oxide system.
.5 Nitrogen system.

1.2 RELATED SECTIONS

.1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.2 Section 23 05 54 - Mechanical Identification.
.3 Section 23 25 00 - Chemical Treatment For Piping.

1.3 REFERENCES

.1 CSA Z7396.1-17 Medical Gas Pipeline Systems - Part 1: Pipelines for Medical Gases and Vacuum.
.2 B51-19 Boiler, Pressure vessel, and Pressure Piping Code.
.3 CAN/CSA Z5359-16 Low Pressure Flexible Hose Assemblies For Use With Medical Gases.
.4 CAN/CSA Z10524-19 Pressure Regulators and Pressure Regulators with Flow Metering Devices for Medical Gas Systems.
.5 C22.1-21 Canadian Electrical Code, Part 1.
.6 ASTM B819-18 Standard Specification for Seamless Copper Tube for Medical Gas Systems.
.7 ASTM G93-19 Standard Practice for Cleaning Methods and Cleanliness Levels for Material and Equipment used in Oxygen Enriched Environments.
.8 AWS A5.8/A5.8M-2019 Filler Metals for Brazing and Braze Welding.
.9 CGA G-4.1-2004 Cleaning Equipment for Oxygen Service.
.10 CGA P-2-2019 Characteristics and Safe Handling of Medical Gases.
.11 CGA V-1-2021 Compressed Gas Cylinder Valve Outlet and Inlet Connections.
.12 CAN/CGSB-24.2-M86 Identification of Medical Gas Containers, Pipelines and Valves.
.13 NFPA 55-20 Compressed Gases and Cryogenic Fluids Code.

1.4 SUBMITTALS FOR REVIEW

.1 Submittals for review as per Division 01 - General Requirements.
.2 Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
.3 Shop Drawings: Indicate general assembly of components, mounting and installation details, and general layout of control and alarm panels.

1.5 SUBMITTALS FOR INFORMATION

.1 Submittals for information as per Division 01 - General Requirements.
.2 Test Reports: Indicate all testing and final Inspection Reports as required by code.
.3 Independent Testing Agency Reports: Indicate systems are complete, zone valves installed, alarm systems functional, and pressure and cross connections tests performed. Document tests.
.4 Certificates: Certify that Products meet or exceed specified requirements.
.5 Manufacturer's Instructions: Indicate installation requirements for equipment and systems.
.6 Manufacturer's Instructions: Indicate installation requirements for equipment and systems.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

.1 Submittals at project closeout, as per Division 01 - General Requirements.
.2 Project Record Documents: Record actual locations of piping, valving, and outlets.

.3 Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
.4 Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.
.5 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

.1 Perform Work to maintain one copy on site at all times.
.2 Installer Qualifications and Responsibilities shall be in Accordance with CSA Z7396.1 - 06.
.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 Conform to applicable code for medical gas systems.
.2 Provide certificate of compliance from authority have jurisdiction.
.3 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

.1 Transport, handle, store, and protect products as per Division 01 - General Requirements
.2 Accept material on site in factory containers and packing. Inspect for damage.
.3 Protect from damage and contamination by maintaining factory packaging and caps in place until installation.

1.10 WARRANTY

.1 Warranty as per Division 01 - General Requirements
.2 Provide five year manufacturer warranty for valves

1.11 EXTRA MATERIALS

.1 Provide two of each size of valve.

2 Products

2.1 MANUFACTURERS

.1 System components shall be as follows:
  .1 All medical gas system components, ie, alarms, shut-off valves and accessories shall be supplied through a single medical gas equipment supplier as approved by the consulting engineer.
  .2 The medical gas equipment supplier shall be responsible for a minimum of 3 visits to the site during the course of construction and installation of the medical gas system. Site visits shall occur at least at the following stages:
    .1 Installation instruction at start of project.
    .2 Commissioning of all equipment ensuring its function and operation prior to certification procedures.
    .3 Available on site during certification procedure.
  .3 Acceptable material: VitalAire.

2.2 PIPE AND FITTINGS

.1 Pipe:
  .1 Tubing shall conform to ASTM Specification B819. Sizes and lengths required are to be determined from the plans. Smallest pipe if not indicated on drawings shall be as per CAN/CSA-Z7396.1.

.2 Pipe Fittings:
- .1 All fittings used for connecting copper pipe shall be:
  - .1 Constructed from wrought copper, brass, or bronze.
- .2 Made especially for soldered or brazed connections.
- .3 Suitable for the maximum pipeline pressure that may be experienced in the construction, testing, and service of the system.
- .4 All piping, assemblies, valves and fittings shall be:
  - .1 Cleaned using methods specified in CGA Standard G-4.1, G-4.1 visually inspected and capped or sealed to prevent contamination; and
  - .2 Labeled, on the part or package, by the manufacturer, e.g., "Clean for Oxygen Service".
- .5 When fitting or other component cannot be obtained as required or become inadvertently contaminated, it shall be thoroughly cleaned of oil, grease and other readily oxidizable material before installation. Cleaning on site shall be achieved using cleaning methods specified in CGA G-4.1.

2.3 NITROUS OXIDE MANIFOLD

.1 Not Used.

2.4 NITROGEN MANIFOLD

.1 Not Used.

2.5 MEDICAL COMPRESSED AIR SYSTEM

.1 Not Used.

2.6 MEDICAL VACUUM SYSTEM

.1 Not Used.

2.7 ANESTHESIA GAS EVACUATION PUMPS

.1 Not Used.

2.8 ORAL EVACUATION PUMPS

.1 Not Used.

2.9 OXYGEN MANIFOLD

.1 Not Used.

2.10 LIQUID OXYGEN STORAGE TANK

.1 Not Used.

2.11 ALARM SYSTEM

.1 Not Used.

2.12 MEDICAL GAS CEILING MOUNTED SERVICE COLUMN "MANUAL RETRACTABLE"

.1 Not Used.

3 Execution

3.1 GENERAL

.1 All of the above piping systems shall be in complete accordance with CSA Standard CAN/CSAZ7396.1-17 and related and referenced standards. In addition to NFPA and CSA Standards, all Provincial and Local codes shall be complied with.

.2 Workmanship shall be first class in every respect.
.3 All suppliers shall be obligated to give technical assistance to the Mechanical Contractor. This supplier shall also, upon completion of the project familiarize the hospital personnel with the function and operation of their portion of the central piping systems installed.
.4 All brazing shall be done in accordance with noted code and requirements of Prince Edward Island Department of Labour.
.5 All brazing procedures shall be registered with the Prince Edward Island Department of Labour.
.6 All brazing procedures shall be done by a person experienced in the installation of medical gas systems. Such a person shall have a minimum of three (3) years experience.
.7 Contractor to provide for structural support of medical gas column in accordance with manufacturers recommendations.

3.2 INSTALLATION

.1 Install to CAN/CSA Z7396.1-17; NFPA 99; and Authority Having Jurisdiction.
.2 Pre-Installation Cleaning: Disassemble positive pressure gas systems pipe, fittings, valves, and components, except those supplied cleaned and prepared for intended service, and thoroughly wash in hot solution of sodium carbonate or trisodium phosphate mixed 1 kg to 25 L of water. After washing, rinse with water, dry and cap until installation.
.3 Braze joints in pipe and tubing. Avoid leaving excess flux inside of pipe and fittings. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
.4 Effect changes in size with reducing fittings. Make changes in direction of required turns or offsets with fittings or tubing shaped by bending tools. Make bends free of flattening, buckling or thinning of tube wall.
.5 Cut pipe and tubing accurately and install without springing or forcing.
.6 Install exposed oxygen piping in wall-mounted sheet steel raceways and junction boxes.
.7 Grade piping down in direction of flow.
.8 Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Finish flush at both ends. Extend 50 mm above finished floors. Pack space between pipe or tubing and sleeve, and caulk.
.9 Identify piping with tape and decals. Provide piping identification code and schematic. Refer to Section 23 05 53. Install labelling on pipe at intervals of not more than 6 metres and at least once in each room and each story traversed by pipeline.
.10 Support gas piping with pipe hooks or hangers suitable for size of pipe, spaced:
    .1 13 mm pipe or tubing: 1830 mm.
    .2 20 mm or 25 mm pipe or tubing: 2440 mm.
    .3 30 mm or larger (horizontal): 3050 mm.
    .4 30 mm or larger (horizontal): 3050 mm.
.11 Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.
.12 Install strainers on inlet side of pressure reducing valves. Provide main gas valves (pressure reducing or flow control) with by-passes and isolation valves to permit maintenance without interruption of gas.
.13 Provide a valved by-pass around receivers.

3.3 FIELD QUALITY CONTROL

.1 Section 01 41 00 - Quality Control: Field inspection.
.2 Independent testing agency to certify system is complete, zone valves installed, alarm systems functional, and tests performed. Document tests and submit.
.3 Reduce pressure in piping systems other than system under investigation to atmospheric.
.4 Test system with dry compressed air or dry nitrogen with test pressure in piping system at 345 kPa.

.5 Check each station outlet of every piping system to determine test gas is dispensed only from outlet of system under investigation. Measure pressure with gauge attached to specific adapter. Do not use universal adapters.

.6 Disconnect test gas and connect proper gas to each system. Purge entire system to remove test gas. Check with analyzer suitable for gas installed.

3.4 PIPE & FITTING

.1 All brazing joints shall be made with silver brazing alloy conforming to AWS Standard BCUP.5 except where permitted by CAN/CSA Z7396.1.

.2 Brazing Temperature: The brazing temperature shall be in the range of 1127ºC min., and 1232ºC max.

.3 The joint shall be brought uniformly to brazing temperature in as short a time as possible to minimize oxidation. Care shall be taken in selecting tip sizes to provide heating quickly and uniformly as described above.

.4 Position: The brazing shall be done in the flat flow vertical-down flow, vertical up flow and horizontal flow position as shown in Q.B. 462 of Section IX of the ASME Code.

.5 Base Metal Thickness: This procedure is proposed to allow for brazing of material thickness between 1.57 mm and 3.96 mm.

.6 Cleaning:

.1 When a fitting or other component cannot be obtained as required, or becomes inadvertently contaminated, it shall be thoroughly cleaned of oil, grease, and other readily oxidation materials by washing a hot solution of sodium carbonate or trisodium phosphate, proportion of one pound to 40 g/L of water.

.2 *THE USE OF ORGANIC SOLVENTS: FOR EXAMPLE, CARBON TETRACHLORIDE, IS PROHIBITED.*

.3 Scrubbing shall be employed where necessary to ensure complete cleaning. After washing, the material shall be rinsed thoroughly in clean hot water. After cleaning, particular care shall be exercised in the storage and handling of all pipe and fittings. Pipe and fittings shall be temporarily capped or plugged to prevent recontamination before final assembly. Tools used in cuttings shall be kept free from oil or grease. Where such contamination has occurred, the items affected shall be rewashed and rinsed. However, care must be taken to clean the joint area of the pipe, tube of fitting with plumbers cloth 120 grit or fitting brush. Tubing shall be pitched downward while cleaning to prevent entry of foreign particles in the pipe or tube. Fittings shall be blown out after cleaning.

.4 NOTE: Files, reamers, sandpaper, steel wool or emery cloth shall NOT be used.

.7 Joints:

.1 All joints shall be of the lap type using socket fittings made especially for brazed connections. The clearance between surfaces to be joined shall not be greater than 0.10 mm or a diametrical clearance of 0.20 mm.

.2 Only pipe cutters in excellent condition shall be used to cut any pipe section.

.3 NOTE: Files, reamers, grinders or hacksaw shall NOT be used.

.8 Purging:

.1 Contractor shall provide Consultant and PEI Department of Labour with written procedures for purging with nitrogen during brazing as well as pre and post purging procedures to ensure no oxidation of the joints takes place.

.9 Post Braze Cleaning:

.1 Where flux is used in dissimilar metal joints, the outside of the brazed connection shall be cleaned by washing with hot water and stainless brush after assembly is complete (where silfos is used on copper to copper without flux, no post braze cleaning is required).

.10 Install pipe straight, parallel and close to the wall and ceilings, with specified pitch. Use standard fittings for directional changes.

.11 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
.12 Copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.
.13 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
.14 Install flanges or unions to permit removal of equipment without disturbing piping systems at sources of supply.
.15 Clean ends of pipes or tubing and recesses of fittings to be brazed. Assemble joints without binding.
.16 All medical gas components shall be stored in a dry area approved by the Consultant, and General Contractor/Owner.
.17 All components shall be kept in containers until installation.
.18 Prior to final acceptance of the medical gas system this Contractor shall coordinate with the hospital the provision for sufficient medical gas to facilitate the testing of the systems as per the code requirements for each respective system.
.19 Identification shall be installed on the piping systems as the pipe is installed.
.20 Wire under 50V, in EMT conduit.
.21 Provide purge valves for testing as required on medical gas piping systems for testing purposes.

3.5 WIRING

.1 The costs for low voltage wiring to be carried by this Trade Contractor. All wiring to be EMT conduit. All wiring to be done in accordance with the Canadian Electrical Code, and the requirements of the electrical specification as noted here within.

3.6 SUPPORTS

.1 The distances maintained between supports shall be in accordance with CAN/CSA Z7396.1 and shall not obstruct the appearance of the marking designating the gas in the particular pipe.

3.7 IDENTIFICATION

.1 Labels or other identifying means are to be utilized to differentiate between the different piping systems being provided. They shall be placed at intervals so as to make them easily recognizable and accessible, and in no case less than required under noted Code. All labels shall be VitalAire 9685 series.

3.8 TESTING AND FINAL INSPECTION

.1 Each section or area, as completed, shall be subjected to testing by means of oil free nitrogen, at a test pressure of 1 1/2 times the maximum working pressure or 1034 kPa which ever is greater. This pressure shall be maintained for minimum of twenty-four (24) hours, with not allowance for loss of pressure. All testing shall be in accordance with noted Code. The Engineer shall be advised to the standing test so that he may be present during the tests.
.2 Advise Engineer prior to tests. Test each system separately as per code.
.3 Each joint shall be examined for leakage by means of chemical leak detector which is oxygen compatible.
.4 If there is a drop in pressure, each joint and the equipment in that area or section shall be inspected and tested for leakage. After leaks have been located and repaired, this section shall be retested as per proceeding paragraph. All gauges and pressure switches shall be disconnected during testing procedure to prevent damage to equipment.
.5 A final test of all systems shall be performed upon completion of all areas or sections. This test shall be performed with a qualified representative from the Engineers office in attendance.

.6 After completion of all testing, all systems shall be purged and gauges and pressure switches placed into position. The systems shall be left under 70 kPa nitrogen pressure until final purging and analysis are performed in accordance with code and Prince Edward Island Department of Labour requirements.

3.9 PIPING SYSTEMS CLEANING AND PRESSURE TESTING

.1 After erection of pipe and tubing but prior to installation of service outlet valves, blow systems clear of free moisture and foreign matter with nitrogen gas.

.2 Install service outlet valves, subject system to test pressure of 1034 kPa with nitrogen or dry compressed air. Check with soapy water. Provide 24-hour standing pressure test.

3.10 PURGING

.1 After the successful completion of the inspection of the sources, the nitrogen blanket shall be purged from each complete pipe line system. They shall then be flushed with the gas to be carried; i.e. oxygen, nitrous oxide, etc., to ensure that all traces of testing gas (nitrogen) are removed from the system.

.2 The Contractor shall obtain the gases necessary to complete the purging, from the hospital's supplies.

3.11 CERTIFICATION

.1 The Owner shall retain an independent testing agency to test the medical gas system for cross connection and purity following installation of all systems. A certified Medical Gas Testing agency shall be disqualified from certifying any system where that same firm has been contracted to perform in a consultant's role throughout the design stage due to the conflict of interest guidelines as articulated by Standards Council of Canada. All testing shall be as outlined in noted Code.

.2 The Contractor shall co-operate with the testing agency in the following manner:

.1 Provide a qualified representative to witness all tests for cross connection and purity.

.2 Provide immediate labour, materials, and equipment to make connections, when required without delay.

.3 Install sensing and regulating devices and equipment as required by the testing agency.

.4 Be prepared to put all medical gas system and equipment into full operation and continue the operation of same during each working day of testing.

.5 Obtain all gases required by the testing agency to complete all testing as indicated in 3.8 above.

.6 Provide all purge valves required by testing agency to complete all testing.

.3 Include in the contract price the costs of all balancing, flow regulating, and sensing device changes as determined by the tests.

.4 Should the independent testing agency find the installed system does not comply with the requirements of the Code, the Contractor shall make good any deficiencies at his own expense and also bear the costs of any standby time and/or retesting required.

.5 Installation shall not be considered complete until final reports by the testing agency are submitted and approved by the Engineer.

.6 After testing, leave medical gas system activated.

END OF SECTION

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1 General

1.1 USE OF SYSTEMS

.1 Use of new permanent heating and/or ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:
- .1 Entire system is complete, pressure tested, cleaned, flushed out.
- .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
- .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .4 There is no possibility of damage from any cause.
- .5 Supply ventilation systems are protected by 60% filters, inspected daily, changed every week or more frequently as required.
- .6 Return systems have approved filters over openings, inlets, outlets.
- .7 All systems will be:
  - .1 Operated as per manufacturer's recommendations and instructions.
  - .2 Operated by Contractor.
  - .3 Monitored continuously by Contractor.
- .8 Warranties and guarantees are not thereby relaxed.
- .9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Consultant.
- .10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.

.2 Filters specified in this Section are over and above those specified in other Sections of this project.

.3 Exhaust systems are not included in approvals for temporary heating ventilation.

END OF SECTION

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1 General

1.1 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.
.2 Shop drawings; submit drawings stamped and signed for review by Owner's representative.
.3 Shop drawings to show:
  .1 Mounting arrangements.
  .2 Operating and maintenance clearances.
.4 Shop drawings and product data accompanied by:
  .1 Detailed drawings of bases, supports, and anchor bolts.
  .2 Acoustical sound power data, where applicable.
  .3 Points of operation on performance curves.
  .4 Manufacturer to certify current model production.
  .5 Certification of compliance to applicable codes.
.5 In addition to transmittal letter referred to in Division 01 - General Requirements: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
.6 Closeout Submittals:
  .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 - General Requirements.
  .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
  .3 Operation data to include:
    .1 Control schematics for systems including environmental controls.
    .2 Description of systems and their controls.
    .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    .4 Operation instruction for systems and component.
    .5 Description of actions to be taken in event of equipment failure.
    .6 Valves schedule and flow diagram.
    .7 Colour coding chart.
  .4 Maintenance data to include:
    .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    .2 Data to include schedules of tasks, frequency, tools required and task time.
  .5 Performance data to include:
    .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    .2 Equipment performance verification test results.
    .3 Special performance data as specified.
    .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  .6 Approvals:
    .1 Submit two (2) copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
    .2 Make changes as required and re-submit as directed by Consultant.
  .7 Additional data:
    .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  .8 Site records:

.1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
.3 Use different colour waterproof ink for each service.
.4 Make available for reference purposes and inspection.

.9 As-built drawings:
.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
.3 Submit to Consultant for approval and make corrections as directed.
.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 - General Requirements.
.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.3 MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 - General Requirements as follows:
.1 One set of packing for each pump.
.2 One casing joint gasket for each size pump.
.3 One head gasket set for each heat exchanger.
.4 One glass for each gauge glass.
.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 - General Requirements.
.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with SDivision 01 - General Requirements.

2 Products

2.1 MATERIALS

.1 All materials used on this project shall be new and CSA approved unless noted otherwise.

3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 00 - Painting.

.2 Prime and touch up marred finished paintwork to match original.
.3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units. Protect open ends of ducts, diffusers, grilles and registers during construction to prevent ingress of dust and dirt into interior of ducts.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Division 01 - General Requirements and submit report as required.
  .1 Submit tests as specified in other sections of this specification.
.2 Manufacturer's Field Services:
  .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

.1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
.4 Instruction duration time requirements as specified in appropriate sections.
.5 Consultant will record these demonstrations on video tape for future reference.

3.5 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 07 84 00 - Firestopping.
.2 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
.4 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.
.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
  .1 Unions are not required in installations using grooved mechanical couplings (the coupling shall serve as the union).
.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.
.4 The flexible ground joint couplings may be used in lieu of a flexible connector at equipment connections for vibration attenuation and stress relief, coupling shall be placed in close proximity to the source of vibration.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.
.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

.1 Install automatic air vents at high points in piping systems.
.2 Install isolating valve at each automatic air valve.
.3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.
.2 Locations: Where dissimilar metals are joined.
.3 NPS 2 and under: isolating unions or bronze valves.
  .1 Waterway fittings shall be complete with thermoplastic liner.
.4 Over NPS 2: Isolating flanges.
  .1 Waterway fittings shall be complete with thermoplastic liner.

3.6 PIPEWORK INSTALLATION

.1 Installed by certified journey person.
.2 Screwed fittings jointed with Teflon tape.
.3 Protect openings against entry of foreign material.
.4 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions.
  .1 Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.
  .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
.5 Push-to-connect piping: Prepare copper tube and install in strict accordance with installation instructions. Pipe ends shall be cleaned, free from indentations, projections, burrs and foreign matter. Use a tube preparation tool as supplied by the manufacturer to clean and make installation mark. Push copper tube into fittings to installation depth mark, per installation instructions. Keep fittings free of dirt and oil.
.6 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
  .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
.8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
.10 Install, except where indicated, to permit separate thermal insulation of each pipe.
.11 Group piping wherever possible and as indicated.
.12 Ream pipes, remove scale and other foreign material before assembly.
.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
.14 Provide for thermal expansion as indicated.
.15 Valves:
  .1 Install in accessible locations.
  .2 Remove interior parts before soldering.
  .3 Install with stems above horizontal position unless otherwise indicated.
  .4 Valves accessible for maintenance without removing adjacent piping.
  .5 Install globe valves in bypass around control valves.
  .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
  .7 Install butterfly valves on chilled water and related condenser water systems only.

.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
.9 Install ball valves for glycol service.
.10 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.16 Check Valves:
.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

.17 Three way Control Valves:
.1 Provide for three (3) way control valve on last three coils on hot water hydronic piping loop to prevent pump from dead head.

3.7 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
.2 The Division 21, 22, 23 & 25 Contractor(s) is financially responsible for all core drilling and sleeves required for their works to pass through floor slabs, foundations and block walls. Coordinate all works with General Contractor and all other Divisions. All core drilling to be performed by a qualified Contractor.
.3 Material: Schedule 40 black steel pipe.
.4 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
.5 Sizes:
.1 Provide 12mm clearance, all around, between sleeve and pipes or between sleeve and insulation.
.2 Through footings use sleeves large enough to accommodate hub of CI soil pipe.
.3 Where piping passes below footings, provide minimum all-round clearance of 50mm between piping and sleeves. Backfill upto underside of footing with concrete of same strength as footing.
.4 Unless otherwise specified, terminate sleeves flush with walls.
.5 Sleeves shall be sized to accommodate the insulated pipe diameter.
.6 Installation:
.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
.2 Other floors: Terminate 25 mm above finished floor.
.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
.7 Sealing:
.1 Foundation walls and below grade floors: Fire retardant, oakum and waterproof non-hardening mastic or manufactured seals equal to "link seal".
.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
.4 Ensure no contact between copper pipe or tube and sleeve.
.8 Unless otherwise indicated for pipes passing through roofs, use Thaler Industries Model MEF-3A or MEF-4A aluminum mechanical flashings, height 300mm. anchor flashings in roof construction. Install in accordance with manufacturers recommendations. Make watertight durable joint.

3.8 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
.2 Uninsulated unheated pipes not subject to movement: No special preparation.
.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
.2 Before start-up, clean interior of piping systems in accordance with requirements of Division 01 - General Requirements, supplemented as specified in relevant sections of Division 23 - HVAC.
.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant 48 hours minimum prior to performance of pressure tests.
.2 Pipework: Test as specified in relevant sections of Division 23.
.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 23.
.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
.5 Conduct tests in presence of Consultant. Work to be carried out in off hours after 5 p.m., weekends or holidays.
.6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.
.7 Insulate or conceal work only after approval and certification of tests by Consultant.

3.12 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Consultant. Work to be carried out in off hours after 5 p.m., weekends or holidays.
.2 Request written approval ten (10) days minimum, prior to commencement of work.
.3 Be responsible for damage to existing plant by this work.
.4 Ensure daily clean-up of existing areas.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Electrical motors, drives and guards for mechanical equipment and systems.
- .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.
- .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of work.
- .3 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Division 01 - General Requirements.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with Provincial Regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Division 01 - General Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

2 Products

2.1 GENERAL

.1 Motors: premium efficiency, in accordance with local utility company standards and to ASHRAE 90.1.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.
.2 Motors under 560 W (3/4 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
.3 Motors 560 W (3/4 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 V, unless otherwise specified or indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
.3 For motors under 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
.4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
.5 Correct size of sheave determined during commissioning.
.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
.7 Motor slide rail adjustment plates to allow for centre line adjustment.
.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS

.1 Provide guards for unprotected drives.
.2 Guards for belt drives;
  .1 Expanded metal screen welded to steel frame.
  .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  .3 38 mm dia holes on both shaft centres for insertion of tachometer.
  .4 Removable for servicing.
.3 Provide means to permit lubrication and use of test instruments with guards in place.
.4 Install belt guards to allow movement of motors for adjusting belt tension.-
.5 Guard for flexible coupling:
  .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  .2 Securely fasten in place.
  .3 Removable for servicing.
.6 Unprotected fan inlets or outlets:
  .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  .2 Net free area of guard: not less than 80% of fan openings.
  .3 Securely fasten in place.

.4 Removable for servicing.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Fasten securely in place.
.2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  .1 As specified in other sections of this specification.
.2 Manufacturer's Field Services:
  .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.
.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 03 20 00 - Concrete Reinforcing.
.2 Section 03 30 00 - Cast-in-Place Concrete.
.3 Section 03 05 10 - Cast-in-Place - Short Form.
.4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
.5 Section 23 08 01 - Performance Verification Mechanical Piping Systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  .2 ASTM A105/A105M, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.
.2 Submit product data and indicate for items as applicable:
  .1 Manufacturer, model number, line contents, pressure and temperature rating.
  .2 Movement handled, axial, lateral, angular and the amounts of each.
  .3 Nominal size and dimensions including details of construction and assembly.
.3 Submit maintenance data in accordance with Division 01 - General Requirements.
.4 Data to include:
  .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect, separate and place in designated containers for reuse packaging Steel in accordance with Waste Management Plan.
.4 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
.5 Fold up metal banding, flatten and place in designated area for recycling.

2 Products

2.1 FLEXIBLE CONNECTION

.1 Application: to suit motion as indicated.
.2 Minimum length in accordance with manufacturer's recommendations to suit offset.
.3 Inner hose: bronze or stainless steel corrugated.
.4 Braided wire mesh bronze or stainless steel outer jacket.
.5 Diameter and type of end connection: threaded or flanged same as pipe joint for the pipe size.
.6 Operating conditions:
  .1 Working pressure: 1034 kPa.
  .2 Working temperature: To match system requirements.

2.2 ANCHORS AND GUIDES

.1 Anchors:
  .1 Provide as indicated.
.2 Alignment guides:
  .1 Provide as indicated
  .2 Concrete: to Section 03 30 00 - Cast in Place Concrete.
  .3 Reinforced: to Section 03 20 00 - Concrete Reinforcing.

3 Execution

3.1 INSTALLATION

.1 Install expansion joints with cold setting. Make record of cold settings.
.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
.3 Install pipe anchors and guides as indicated. Anchors to withstand 150 % of axial thrust.

3.2 CLEANING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.3 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems: Mechanical Piping Systems.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Section 23 05 54 - Mechanical Identification.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
  .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
  .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
.2 Canadian General Standards Board (CGSB).
  .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
  .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit manufacturer's product data for following items:
  .1 Thermometers.
  .2 Pressure gauges.
  .3 Stop cocks.
  .4 Syphons.
  .5 Wells.
.3 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.
.2 Collect, separate and place in designated containers for reuse and recycling, paper, plastic, polystyrene, corrugated cardboard packaging, steel, metal, in accordance with Waste Management Plan.
.3 Fold up metal banding, flatten and place in designated area for recycling.
.4 Place materials defined as hazardous or toxic waste in designated containers.
.5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.
.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, accuracy +/- scale division 225 mm scale length: to CAN/CGSB14.4 or ASME B 40, 200.

.1 Acceptable material: Trerice, Ashcroft, Wika, Winters, Marsh.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.
.2 Steel pipe: brass.

2.4 REMOTE READING THERMOMETERS

.1 100mm diameter liquid filled or vapor activated dial type: to CAN/CG SB - 14.4 or ASME B40-200, accuracy within one scale division. Brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb, and polished brass or stainless steel case for wall mounting.
  .1 Acceptable material: Trerice, Ashcroft, Wika, Winters, Marsh.

2.5 PRESSURE GAUGES

.1 Dial type 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale, 1% accuracy for liquid filled.
  .1 Acceptable material: Trerice, Ashcroft, Wika, Winters, Marsh.
.2 Provide bronze stop cock and :
  .1 Siphon for steam service.
  .2 Snubber for pulsating operation.
  .3 Diaphragm assembly for corrosive service.
  .4 Gasketed pressure relief back with solid front.
  .5 Oil filled for high vibration applications such as pumps.
  .6 Bronze ball valve to Section 23 05 22 - Valves - Bronze.

3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping arrange so that at least 25mm (1") of the stem of the thermometer is immersed in flowing fluid. Provide heat conductive material inside well.
.2 Install on inlet and outlet of equipment:
  .1 Heat exchangers.
  .2 Heating and cooling coils.
  .3 Boilers.
  .4 Chillers.
  .5 Cooling towers, closed circuit coolers and evaporative condensers
  .6 DHW tanks.
.3 Install wells in other locations as indicated.
.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:
  .1 Suction and discharge of pumps (liquid filled).
  .2 Upstream and downstream of PRV's.
  .3 Upstream and downstream of control valves.
  .4 Inlet and outlet of coils.
  .5 Inlet and outlet of heat exchanger.
  .6 Outlet of boilers.

.7 In other locations as indicated.

.2 Install ball valves to Section 23 05 22 - Valves - Bronze.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 54 - Mechanical Identification, identifying medium.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Bronze - valves.

1.2 RELATED SECTIONS

.1 Section 23 05 01 - Installation of Pipework.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME B1.20.1 (R2001), Pipe Threads, General Purpose (Inch).
- .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16-22 Wrought Copper and Copper Alloy Soldier Joint Pressure Fittings.

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A276, Specification for Stainless Steel Bars and Shapes.
- .2 ASTM A536, Specifications for Ductile Iron Castings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 ASTM B16 Specifications for Free Cutting Brass Rod Bar and Shapes for use in Screw Machines.
- .5 ASTM B283, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
- .6 ASTM B505/B505M, Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
- .2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.
- .3 MSS-SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- .4 Canadian Standards Association (CSA)
  - .1 CSA B242, Groove and Solder type mechanical pipe couplings.

1.4 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.
- .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
- .2 Submit data for valves specified in this section.
- .3 Groove joint couplings and fittings to be indicated on product submittals and to be specifically identified with applicable style or series designation.

.3 Closeout Submittals:
- .1 Submit maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.5 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health, Safety and Emergency Response Procedures.

1.6 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.
.2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.7 MAINTENANCE

.1 Extra Materials:
.2 Furnish following spare parts:
.1 Valve seats: one for every 10 valves each size, minimum 1.
.2 Discs: one for every 10 valves, each size. Minimum 1.
.3 Stem packing: one for every 10 valves, each size. Minimum 1.
.4 Valve handles: 2 of each size.
.5 Gaskets for flanges: one for every 10 flanged joints.
.6 Grooved Couplings: IPS and copper tube dimensions, one for every 10 (ten) ground joints.

2 Products

2.1 MATERIALS

.1 Valves:
.1 Except for specialty valves, to be single manufacturer.
.2 All products to have CRN registration numbers.
.2 End Connections:
.1 Connection into adjacent piping/tubing:
.1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
.2 Copper tube systems:
.1 Solder ends to ANSI/ASME B16.18.
.2 Grooved ends to copper tube dimension and CSMB242
.3 Push-to-connect ends to ANSI/ASME B16.22 and manufacturers standards.
.3 Lockshield Keys:
.1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron

2.2 CHECK VALVES

.1 Requirements common to check valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Connections: screwed with hexagonal shoulders.
.1 Class 125, WP = 860 kPa (125 psi) 1.4 MPa (200psi) WOG
.2 Class 150, WP = 1.03 MPa
.3 200 6WP, WP = 1.4 MPa (200psi) Water.
.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
.3 NPS 2 and under, swing type, bronze disc:
.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
.4 NPS 2 and under, swing type, composition disc, 200 CWP:
.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
.1 Body: with integral seat, union bonnet ring with hex shoulders, cap.

.2 Disc: renewable PTFE for steam, #6 composition rotating disc for water, oil, or gas service in disc holder having guides top and bottom, of bronze to ASTM B62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
- .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

.7 NPS 2 and under vertical on horizontal lift type 1380kPa CWP:
- .1 Disc type 301 stainless steel, center guided.

2.3 SILENT CHECK VALVES

.1 NPS 2 and under:
- .1 Body: cast high tensile bronze to ASTM B16 or ASTM B62 with integral seat.
- .2 Pressure rating: Class 125, MPa Steam.
- .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
- .4 Disc and seat: renewable rotating disc.
- .5 Stainless steel spring, heavy duty.
- .6 Seat: regrindable.

2.4 BALL VALVES

.1 NPS 2 and under:
- .1 Body and cap: cast high tensile bronze to ASTM B62.
- .2 Pressure rating: Class125, 860 kPa steam.
- .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders, push to connect press fit ends.
- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel solid ball of hand chrome plated brass solid ball and teflon seats.
- .7 Stem seal: TFE EPDM, Nitrile, Flooroelustomer with external packing nut.
- .8 Operator: removable lever handle.
- .9 Cup and drain for service.
- .10 Acceptable material: Jenkins Fig 201J or equal.

2.5 BUTTERFLY VALVES

.1 NPS 2-1/2 through NPS 6.
- .1 Body: cast bronze per CDA-836 (85-5-5-5).
- .2 Pressure rating: 2065-kPa CWP.
- .3 Connections: copper tube dimensioned grooved ends.
- .4 Disc: ductile iron per ASTM A536 with elastomer coating.
- .5 Stem: integrally cast with disc.
- .6 Stem Nuts: nickel plated 416 stainless steel.
- .7 Operator: gear operator, NPS and over.

2.6 GATE VALVES

.1 Requirements common to all gate valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80.
- .2 Bonnet: with hex. shoulders.
- .3 Connections: with hex. shoulders.
- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Packing: high grade non-asbestos packing.
- .6 Handwheel: non-ferrous.
- .7 Handwheel Nut: bronze to ASTM B62.
- .8 Class 125, WP = 860 kPa steam, 1.4 mPa WOG.
- .9 Class 150 WP = 1.03 mPa steam, 2.07 mPa WOG.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125:
- .1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Handwheel.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
- .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
- .2 Operator: Handwheel.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:
- .1 Body: with long disc guides, screwed bonnet.
- .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
- .3 Operator: Handwheel

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
- .1 Body: with long disc guides, screwed bonnet.
- .2 Operator: Handwheel.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
- .1 Body: with long disc guides, screwed bonnet.
- .2 Operator: Handwheel.

2.7 GLOBE VALVES

.1 Requirements common to all globe valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80.
- .2 Bonnet: union with hex. shoulders.
- .3 Connections: screwed with hex. shoulders.
- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Packing: non-asbestos.
- .6 Handwheel: non-ferrous.
- .7 Handwheel Nut: bronze to ASTM B62.
- .8 Class 125, WP = 860 kPa steam, 1.4 MPa WOG.
- .9 Class 150 WP = 1.03 mPa steam, 2.07 MPa WOG.

.2 NPS 2 and under, composition disc, Class 125:
- .1 Body and bonnet: screwed bonnet.
- .2 Disc and seat: renewable rotating PTFE disc regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
- .3 Operator: Handwheel.

.3 NPS 2 and under, composition disc, Class 150:
- .1 Body and bonnet: union bonnet.
- .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
- .3 Operator: Handwheel.
- .4 Acceptable material: Jenkins Figure 106BJ or equal.

.4 NPS 2 and under, plug disc, Class 150, screwed ends:
- .1 Body and bonnet.
- .2 Disc and seat ring: tapered plug type with disc stem ring of stainless steel to ASTM A276, loosely secured of stem.
- .3 Operator: Handwheel.
- .4 Acceptable material: Jenkins Figure 2032J or equal

.5 Angle valve, NPS 2 and under, composition disc, Class 150:
- .1 Body and bonnet: union bonnet.
- .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
- .3 Operator: Handwheel.
- .4 Acceptable material: Jenkins Figure 108BJ or equal.

2.8 ACCEPTABLE MATERIAL

.1 Jenkins, Crane, Watts, Newman Hattersley, Milwaukee, Conbraco, Kitz, Red White, M.A. Stewart, Nibco, Victaulic, Boshart.

3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.
.2 Remove internal parts before soldering.
.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.
  .1 Unions are not required in Installations using ground mechanical couplings. The couplings shall serve as unions.
.4 Add joining tube, couplings and fittings with grooved joint valves shall be copper tube dimensioned. Tlaring tube or fitting ends to accommodate IPS sized valves is not permitted.

3.2 COMMISSIONING

.1 As part of commissioning activities, develop a schedule and valves and record there on there as identifier, location, services, purchase order number and date, manufacturer, identification data specified above.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Related Sections:
- .1 Section 23 05 01 - Installation of Pipework.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME B16.1-, Cast Iron Pipe Flanges and Flanged Fittings.

.2 American Society for Testing and Materials International (ASTM).
- .1 ASTM A49-, Specification for Heat-Treated Carbon Steel Joint Bars.
- .2 ASTM A126-, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .3 ASTM B61-, Specification for Steam or Valve Bronze Castings.
- .4 ASTM B62-, Specification for Composition Bronze or Ounce Metal Castings.
- .5 ASTM B85-, Specification for Aluminum-Alloy Die Castings.
- .6 ASTM B209-, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 MSS SP-67 Butterfly Valves.
- .2 MSS SP-70-, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS SP-71-, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS SP-82-, Valve Pressure Testing Methods.
- .5 MSS SP-85-, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.
- .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
- .2 Submit data for valves specified in this section.

.3 Closeout Submittals:
- .1 Submit maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:
- .1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.
- .2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.6 MAINTENANCE

.1 Extra Materials:

.2 Furnish following spare parts:
- .1 Valve seats: one for every 10 valves each size, minimum 1.
- .2 Discs: one for every 10 valves, each size. Minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.
.4 Valve handles: 2 of each size.
.5 Gaskets for flanges: one for every 10 flanged joints.

2 Products

2.1 MATERIAL

.1 Valves:
  .1 Except for specialty valves, to be of single manufacturer.
.2 Standard specifications:
  .1 Gate valves: MSS SP-70.
  .2 Globe valves: MSS SP-85.
  .3 Check valves: MSS SP-71.
.3 Requirements common to valves, unless specified otherwise:
  .1 Body, bonnet: cast iron to ASTM B209 Class B.
  .2 Connections: flanged ends plain face to ANSI B16.1.
  .3 Inspection and pressure testing: to MSS SP-82.
  .4 Bonnet gasket: non-asbestos.
  .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
  .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
  .7 Gland packing: non-asbestos.
  .8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
  .9 Identification tag: with catalogue number, size, other pertinent data.
.4 All products to have CRN registration numbers.
.5 Bronze trim for steam, water, air or glycol services. Iron trim for oil, gas or gasoline.
.6 Acceptable material: Crane, Jenkins, Milwaukee, Newman Hattersley, Kite, M.A. Stewart, NIBCO.

2.2 GATE VALVES

.1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze or iron trim, solid wedge disc:
  .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 125.
  .2 Bronze trim.
    .1 Disc: solid offset taper wedge, bronze to ASTM B62.
    .2 Seat rings: renewable bronze to ASTM B62, screwed into body.
    .3 Stem: bronze to ASTM B62.
      .1 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
      .2 Seat: Integral with body.
      .3 Stem: wrought steel.
      .4 Operator: Handwheel.
.2 NPS 10 - 24, non rising stem, inside crew, bronze trim, solid wedge disc:
  .1 Body and multiple-bolted bonnet: cast iron to ASTM A126 Class B for sizes up to NPS 14, Class C for sizes NPS 16 and over, with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges.
  .2 Pressure ratings: Class 125.
  .3 Bronze trim.
  .4 Iron trim.
    .1 Disc: solid offset taper wedge, with bronze rings to ASTM B62 rolled into cast iron disc, secured to stem.
    .2 Seat rings: renewable bronze to ASTM B62 screwed into body.

.3 Stem: bronze to ASTM B62.
.1 Disc: solid offset taper wedge, cast iron secured to stem.
.2 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.
.3 Stem: wrought steel.
.4 Operator: Handwheel.

.3 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
.1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
.2 Bronze trim.
.1 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
.2 Seat rings: renewable bronze screwed into body.
.3 Stem: manganese bronze.
.3 Iron trim.
.1 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
.2 Seat rings: integral with body.
.3 Stem: nickel-plated steel.
.4 Pressure-lubricated operating mechanism.
.5 Operator: Handwheel.

.4 NPS 10 - 24, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
.1 Body and multiple-bolted bonnet: NPS 10 - 14: cast iron to ASTM A126 Class B. With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges, yoke, yoke hub, yoke sleeve and nut.
.2 Pressure ratings: Class 125.
.1 NPS 10-12: WP = 1.4 Mpa CWP.
.2 NPS 14-24: WP = 1.03 Mpa CWP.
.3 Bronze trim.
.1 Disc: solid offset taper wedge, bronze disc rings to ASTM B62 rolled into cast iron disc, secured to stem through integral forged T-head disc-stem connection.
.2 Seat rings: renewable bronze to ASTM B62 screwed into body.
.3 Stem: Manganese bronze
.4 Iron trim.
.1 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
.2 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.
.3 Stem: nickel-plated steel.
.4 Pressure-lubricated operating mechanism.
.5 Operator: Handwheel.

2.3 UNDERWRITERS APPROVED GATE VALVE

.1 NPS 2 1/2 - 14, OS&Y:
.1 Approvals: UL and FM approved for fire service.
.2 UL and FM Label: on valve yoke.
.3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC 262 (B).
.4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
.5 Packing gland: bronze.
.6 Stem: manganese bronze. Diameter to ULC C-262 (B).

.7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
.8 Bosses for bypass valve, drain: on NPS 4 and over.
.9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: cast iron with bronze disc rings.
.10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
.11 Pressure rating:
.1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
.2 NPS 14-1.2: 1.2 MPa CWP.
.12 Operator: handwheel.

2.4 GLOBE VALVES

.1 NPS 2 1/2 - 10, OSY:
.1 Body: with multiple-bolted bonnet.
.2 WP: 860 kPa steam, 1.4 MPa CWP.
.3 Bonnet-yoke gasket: non-asbestos.
.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
.5 Seat ring: renewable, regrindable, screwed into body.
.6 Stem: bronze to ASTM B62.
.7 Operator: Handwheel.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

.1 Locations: on valves as indicated.
.2 Position of bypass valve on main valves: spindle uprights or parallel position.
.3 Size of bypass valve:
.1 Main valve up to NPS 8: NPS 3/4.
.2 Main valve NPS 10 and over: NPS 1.
.4 Type of bypass valves:
.1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 22 - Valves - Bronze. Pressure rating to match main valve.
.2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 22 - Valves - Bronze. Pressure rating to match main valve.

2.6 VALVE OPERATORS

.1 Install valve operators as follows:
.1 Handwheel: on valves except as specified.
.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

2.7 CHECK VALVES

.1 Swing check valves, Class 125:
.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
.1 Up to NPS 16: cast iron to ASTM A126 Class B.
.2 NPS 18 and over: cast iron to ASTM A126 Class C.
.2 Ratings:
.1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
.2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
.3 NPS 18 and over: 1.03 MPa CWP.
.3 Bronze trim.
.1 Disc: rotating for extended life.
.1 Up to NPS 6: bronze to ASTM B 62.
.2 NPS 8 and over: bronze-faced cast iron.
.3 Seat rings: renewable bronze to ASTM B62 screwed into body.

.4 Hinge pin, bushings: renewable bronze to ASTM B62.

.4 Iron trim.
- .1 Disc: A126 Class B, secured to stem, rotating for extended life.
- .2 Seat: cast iron, integral with body.
- .3 Hinge pin: exelloy; bushings: malleable iron.

.5 Identification tag: fastened to cover.

.6 Hinge: galvanized malleable iron.

.2 Swing check valves, NPS 2 1/2 - 8 Class 250:
- .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
- .2 Flanged ends: 2 mm raised face with serrated finish.
- .3 Rating: 250 psi steam; 500 psi CWP.
- .4 Disc: rotating for extended life.
  - .1 Up to NPS 3: bronze to ASTM B61.
  - .2 NPS 4 - 8: Iron faced with ASTM B61 bronze.
- .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
- .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
- .7 Hinge: galvanized malleable iron.
- .8 Identification tag: fastened to cover.

2.8 SILENT CHECK VALVES

.1 Construction:
- .1 Body: malleable or ductile iron with integral seat.
- .2 Pressure rating: class 125, WP = 860 kPa.
- .3 Connections: grooved ends or flanged ends.
- .4 Disc: bronze or stainless steel renewable rotating disc.
- .5 Seat: renewable, EPDM.
- .6 Stainless steel spring, heavy duty.
- .7 Grooved end check valves.

2.9 GROOVED END BUTTERFLY VALVES

.1 Butterfly valves: to MSS-SP-67. Application: Isolating coils or section of multiple component equipment (eg multi-section coils, multi-cell
- .1 NPS 2 cooling towers and over: grooved ends.
- .2 2068 kPa WOG and bath bi-directional and dead end service capable to fall rated pressure, ductile iron body with blow-out proof stainless steel stems and nickel coated ductile iron disc. Seat shall be "EPDM" and have a full 360 degree continuous contract with the seating surface.
- .3 Valve operations: level, gear operator NPS 6 and over.

2.10 ACCEPTABLE MATERIAL

.1 Jenkins, Crane, Wath, Newman, Hatersley, Milwaukee, Conbraco, Kitz, Red Wine, M.A. Stewart, Nibco, Victaulic.

.2 Grooved end valves to be supplied by the same manufacturer as the grooved fittings.

.3 Grooved end valves to be installed in accordance with the manufacturer's written installation instructions. Grooved ends to be clean and free from indentations and projections. Gaskets to be verified as suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative to provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative to periodically visit the jobsite and review installation. Contractor to remove and replace any joints deemed improperly installed.

3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

3.2 COMMISSIONING

.1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date and manufacturer.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
- .1 ANSI/ASME B31.1-04, Power Piping.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:
- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to structure.
- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.4 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.

.2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Prince Edward Island, Canada.

.3 Submit shop drawings and product data for following items:
- .1 Bases, hangers and supports.
- .2 Connections to equipment and structure.
- .3 Structural assemblies.

.4 Closeout Submittals:
- .1 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.5 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:
- .1 Pipe hangers and supports: galvanized after manufacture.
- .2 Use electro-plating galvanizing process.
- .3 Ensure steel hangers in contact with copper piping are copper plated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:
- .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and.
  - .1 Rod: 9 mm UL listed.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved.

.3 Upper attachment structural: suspension from upper flange of I-Beam:
- .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete:
- .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.

.5 Shop and field-fabricated assemblies:
- .1 Trapeze hanger assemblies: Grinnel.
- .2 Steel brackets: Grinnel.

.6 Hanger rods: threaded rod material to MSS SP58:
- .1 Ensure that hanger rods are subject to tensile loading only.
- .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .3 Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP58:
- .1 Attachments for steel piping: carbon steel black.
- .2 Attachments for copper piping: copper plated black steel.
- .3 Use insulation shields for hot pipework.
- .4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .1 Ensure "U" has hole in bottom for riveting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
- .1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: black.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.
.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
.3 Bolts: to ASTM A307.
.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:
  .1 64 kg/m3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
.2 Insulated hot piping:
  .1 Curved plate 300 mm long, with edges turned up, welded-in center plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting NBC. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.7 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
.2 Concrete: to Section 03 30 00 - Cast-in-place Concrete.

2.8 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting NBC.
.2 Submit structural calculations with shop drawings.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:
  .1 Manufacturer's instructions and recommendations.
.2 Vibration Control Devices:
  .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
.3 Clamps on riser piping:
  .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  .2 Bolt-tightening torques to industry standards.
  .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  .4 Cast iron pipes: install below joint.
.4 Clevis plates:
  .1 Attach to concrete with 4 minimum concrete inserts, at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
.6 Use approved constant support type hangers where:
  .1 Vertical movement of pipework is 13 mm or more,
  .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
.7 Use variable support spring hangers where:
  .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code.
.2 Fire protection: to applicable fire code.
.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
.4 Copper piping: up to NPS 1/2: every 1.5 m.
.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
.6 Within 300 mm of each elbow.

Max Piping Size: NPS	Max Spacing Steel	Max Spacing Copper
up to 1-1/4	2.1m	1.8m
1-1/2	2.7m	2.4m
2	3.0m	2.7m
2-1/2	3.6m	3.0m
3	3.6m	3.0m
3-1/2	3.9m	3.3m
4	4.2m	3.6m
5	4.8m	
6	5.1m	
8	5.7m	
10	6.6m	
12	6.9m	
Pipework greater than NPS 12: to MSS SP69.		

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.
.2 Adjust hangers to equalize load.
.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
  .1 Ensure that rod is vertical under operating conditions.
  .2 Equalize loads.
.2 Adjustable clevis:
  .1 Tighten hanger load nut securely to ensure proper hanger performance.
  .2 Tighten upper nut after adjustment.

.3 C-clamps:
  .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
.4 Beam clamps:
  .1 Hammer jaw firmly against underside of beam.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 RELATED SECTIONS

- .1 Section 03 30 33 - Cast in Place Concrete.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.3 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)
- .1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC)

1.4 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.

.2 Submit shop drawings in accordance with Division 01 - General Requirements.
- .1 Provide separate shop drawings for each isolated system complete with performance and product data.
- .2 Shop drawings; submit drawings stamped and signed for approval by Consultant.
- .3 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
  - .1 Consultant will make available one (1) copy of systems supplier's installation instructions
- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 ADDITIONAL REQUIREMENTS

.1 The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment.
- .1 Obtain from the Architect the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical and electrical equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.

.2 Obtain all necessary date in regard to piping systems which are to be resiliency supported so that proper isolators can be selected. Select piping system isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.

.3 Submit shop drawings as required by other portions of this specification. These drawings shall include specification information as follows:

.1 Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.

.2 For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.

.3 For elastomer or glass fiber isolators - free height, deflected height, and isolator loading.

.4 Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

.4 Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with normally accepted practices for critical environments.

.5 Replace at no extra cost to the Owner and isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which in any way do not produce the required isolation.

.6 Cooperate with all other Contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.

.7 Notify the Architect of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibration isolation system installation proceed without such notifications any remedial work required to achieve proper isolator performance shall be accomplished by the Contractor at no additional cost to the Owner.

.8 Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Architect so that preventive or remedial action can take place on a timely basis. Any remedial measures required shall be undertaken by the contractor responsible at no additional cost to the Owner.

1.6 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with SDivision 01 - General Requirements.

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

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

2 Products

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.
.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
.3 Type EP3 - neoprene-steel-neoprene; 9mm minimum thick neoprene bonded to 1.71mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with leveling devices.
.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
.3 Cadmium plate for outdoor installations, 100% relative humidity.
.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; leveling bolt for rigidly mounting to equipment.
.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
.6 Acceptable material: Korfund, Masdom, Vibron, Vibro Acoustics, Mason

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.
.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
.4 Type H3 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.
.5 Acceptable material: Korfund, Masdom, Vibron, Vibro Acoustics, Mason.

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
.3 Bases to clear housekeeping pads by 25 mm minimum.
.4 Acceptable material: Korfund, Masdom, Vibron, Vibro Acoustics, Mason.

2.10 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.
.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.
.3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.
.4 Acceptable material: Korfund, Masdom, Vibron, Vibro Acoustics, Mason.

2.11 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled without need for sub-base.
.2 Lower member: continuous rectangular steel tube or extruded aluminum channel.
.3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.
.4 Springs: steel, adjustable, removable, selected for 50 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
.5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly, or pads on top and bottom of each spring. Material: closed cell neoprene.
.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum or neoprene.
.7 Hardware: cadmium plated or galvanized.

2.12 SEISMIC CONTROL MEASURES

.1 General:
  .1 Following systems and/or equipment to remain operational during and after earthquakes:
    .1 AC Units

.2 Air Distribution Boxes
.3 Comp. Room Units
.4 Condensing Units
.5 Ductwork
.6 Light Fixtures
.7 Piping (all types)
.8 Fans All Types

.2 Seismic control systems to work in every direction.
.3 Fasteners and attachment points to resist same maximum load as seismic restraint.
.4 Drilled or power driven anchors and fasteners not permitted.
.5 No equipment, equipment supports or mounts to fail before failure of structure.
.6 Supports of cast iron or threaded pipe not permitted.
.7 Seismic control measures not to interfere with integrity of firestopping.

.2 Static equipment:
.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
.2 Suspended equipment:
.1 Use one or more of following methods depending upon site conditions:
.1 Install tight to structure.
.2 Cross brace in every direction.
.3 Brace back to structure.
.4 Cable restraint system.
.3 Seismic restraints:
.1 Cushioning action gentle and steady.
.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:
.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
.3 As indicated.

.4 Piping systems:
.1 Fire protection systems: to NFPA 13.
.2 Piping systems: hangers longer than 300 mm; brace at each hanger.
.3 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:
.1 Approved by Consultant.
.2 Structural angles or channels.
.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Seismic control measures to meet requirements of NBC (delete this where seismic control measures are not required on project).
.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.1 Manufacturer's Field Services: consisting of product use recommendations and site visits for inspection of product installation in accordance with manufacturer's instructions.

.2 Submit reports to Consultant within 3 days of manufacturer representative's final review.

.2 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.2 Take vibration measurements for equipment as indicated.

.3 Provide Consultant with notice 24 h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.5 Submit complete report of test results including sound curves.

3.4 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 RELATED SECTIONS

.1 Section 09 91 00 - Painting.

1.3 REFERENCES

.1 Canadian Gas Association (CGA)
- .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 CSA 7396.1 Medical Gas Pipeline Systems - Part 1: Pipelines for Medical Gases and Vacuum.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)
- .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.4 SUBMITTALS

.1 Product Data:
- .1 Submittals: in accordance with Division 01 - General Requirements.
- .2 Product data to include paint colour chips, other products specified in this section.
- .3 Samples:
  - .1 Submit samples in accordance with Division 01 - General Requirements.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.5 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.

.2 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Division 01 - General Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.
- .2 Dispose of unused paint material at official hazardous material collections site approved by Owner's Representative.
- .3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
.2 Lettering and numbers raised or recessed.
.3 Information to include, as appropriate:
  .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:
  .1 Hazardous: red letters, white background.
  .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
.2 Construction:
  .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
.3 Sizes:
  .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 100	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

  .2 Use maximum of 25 letters/numbers per line.
.4 Locations:
  .1 Terminal cabinets, control panels: use #5.
  .2 Equipment in Mechanical Rooms: use #9.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.
.2 Where existing identification system does not cover for new work, use identification system specified this section.
.3 Before starting work, obtain written approval of identification system from Consultant.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:
  .1 Natural gas: to CSA/CGA B149.1.
  .2 Propane gas: to CSA/CGA B149.1.
  .3 Sprinklers: to NFPA 13.
  .4 Standpipe and hose systems: to NFPA 14.
  .5 Medical Gas: to CAN/CSA Z 7396.1.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive plastic-coated cloth with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Owner's Representative.

Background colour:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.2 Colours for legends, arrows: to following table:

Contents	**Background colour marking**	**Legend**
Raw Water	Green	RAW WATER
River water	Green	RIVER WATER
Sea water	Green	SEA WATER
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Brine	Green	BRINE
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR

Contents	Background colour marking	Legend
Steam ___kPa	Yellow	___kPa STEAM
Steam Cond. (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam Cond. (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
Intermittent blow-off	Yellow	INT. BLOW-OFF
Continuous blow-off	Yellow	CONT. BLOW-OFF
Chilled drinking water	Green	CH. DRINK WTR
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Dom. cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Contaminated lab waste	Yellow	CONT. LAB WASTE
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
No. ___ fuel oil suction	Yellow	#___ FUEL OIL
No. ___ fuel oil return	Yellow	# ___ FUEL OIL
Engine exhaust	Yellow	ENGINE EXHAUST
Lubricating oil	Yellow	LUB. OIL
Hydraulic oil	Yellow	HYDRAULIC OIL
Gasoline	Yellow	GASOLINE
Natural gas	to Codes	
Propane	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Chlorine	Yellow	CHLORINE
Nitrogen	Yellow	NITROGEN
Oxygen	Yellow	OXYGEN
Compressed air (700kPa)	Green	COMP. AIR ___ kPa
Compressed air (>700kPa)	Yellow	COMP. AIR ___ kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Carbon dioxide	Red	CO2
Instrument air	Green	INSTRUMENT AIR
**Add design temperature		
++Add design temperature and pressure		

.3 Background colour marking and legends for piping systems:

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stenciled letters and directional arrows 150 mm long x 50 mm high.
.2 Colours: back, or coordinated with base colour to ensure strong contrast.
.3 Identify Systems: eg Supply AHU-1, Exhaust EF-1

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.
.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
.2 Inscriptions to include function and (where appropriate) fail-safe position, component ID name.

2.9 LANGUAGE

.1 Identification in English.
.2 Use one nameplate and label for each language.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

.1 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
.2 Provide ULC and CSA registration plates as required by respective agency.

3.4 NAMEPLATES

.1 Locations:
  .1 In conspicuous location to facilitate easy reading and identification from operating floor.
.2 Standoffs:
  .1 Provide for nameplates on hot and/or insulated surfaces.
.3 Protection:
  .1 Do not paint, insulate or cover in any way.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
.2 Adjacent to each change in direction.
.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.
.5 On both sides of separations such as walls, floors, partitions.
.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
.7 At beginning and end points of each run and at each piece of equipment in run.
.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
.9 Identification easily and accurately readable from usual operating areas and from access points.
.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
.3 Number valves in each system consecutively.

3.7 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.
.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Consultant within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience. TAB Contractor shall have a minimum of five (5) years experience to AABC, NBC, NEBB or SMACNA

.3 TAB: performed in accordance with the requirements of Standard under which TAB Firm's qualifications are approved:

- .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
- .2 National Balancing Council (NBC) Certified Air Balancing Specifications and Certified Hydronic Balancing Specifications.
- .3 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

- .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
- .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started confirm in writing to Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Consultant in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.9 START OF TAB

.1 Notify Consultant seven (7) days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

- .1 Installation of ceilings, doors, windows, other construction affecting TAB.
- .2 Application of weatherstripping, sealing, and caulking.
- .3 Pressure, leakage, other tests specified elsewhere Division 23.
- .4 Provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

- .1 Proper thermal overload protection in place for electrical equipment.
- .2 Air systems:
  - .1 Filters in place, clean.
  - .2 Duct systems clean.
  - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
  - .4 Correct fan rotation.
  - .5 Fire, smoke, volume control dampers installed and open.
  - .6 Coil fins combed, clean.
  - .7 Access doors, installed, closed.
  - .8 Outlets installed, volume control dampers open.
- .3 Liquid Systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolation and balancing valves installed and open.
  - .5 Calibrated balancing valve installed at factory settings.
  - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:
- .1 Laboratory and hospital HVAC Systems: plus 10%, minus 0%.
- .2 Other HVAC Systems: plus 5%, minus 5%.
- .3 Hydronic Systems: plus or minus 10%.
- .4 Refrigeration Systems: plus or minus 10%

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Consultant list of instruments used together with serial numbers.
.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Consultant.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:
- .1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.

1.15 TAB REPORT

.1 Format in accordance with referenced standard.
.2 TAB report to show results in SI units and to include:
- .1 Project record drawings.
- .2 System schematics.

.3 Submit three (3) copies of TAB Report to Consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Consultant.
.2 Provide personnel and instrumentation to verify up to 30 % of reported results.
.3 Number and location of verified results as directed by Consultant.
.4 Pay costs to repeat TAB as required to satisfaction of Consultant.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Consultant, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Consultant.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section.
.2 Do TAB of systems, equipment, components, controls specified in other Divisions.
.3 Qualifications: personnel performing to be qualified to Standards of AABC, NBC or NEBB.
.4 Quality assurance: perform TAB under direction of supervisor qualified to Standards of AABC, NBC, or NEBB.
.5 Measurements: to include as appropriate for systems, equipment, components, controls:
  .1 Air velocity
  .2 Static pressure
  .3 Flow rate
  .4 Pressure drop (or loss)
  .5 Temperatures (dry bulb, wet bulb, dewpoint)
  .6 Duct cross-sectional area
  .7 RPM
  .8 Electrical power
  .9 Voltage
  .10 Noise
  .11 Vibration
  .12 Amperage and volts for each stage of electric heating coils.
.6 Locations of equipment measurements: to include but not be limited to, following as appropriate:
  .1 Inlet and outlet of dampers
  .2 Filter
  .3 Coil
  .4 Humidifier
  .5 Fan
  .6 Other equipment causing changes in conditions.
  .7 Controllers.
  .8 Controlled device.
.7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 HYDRONIC SYSTEMS

.1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.
.2 Standard: TAB to be to most stringent of TAB standards of AABC, NBC or NEBB.
.3 Do TAB of systems, equipment, components, controls specified in other Divisions.
.4 Qualifications: personnel performing TAB to be qualified to standards of AABC, NBC or NEBB.
.5 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC, NBC or NEBB.
.6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls:
  .1 Flow rate
  .2 Static pressure
  .3 Pressure drop (or loss)
  .4 Temperature
  .5 Specific gravity
  .6 Density
  .7 RPM
  .8 Electrical power
  .9 Voltage
  .10 Noise

.11 Vibration

.7 Locations of equipment measurement: to include, but not limited to, following as appropriate:
- .1 Inlet and outlet of heat exchangers (primary and secondary sides)
- .2 Boiler
- .3 Chiller
- .4 Coil
- .5 Humidifier
- .6 Cooling tower
- .7 Condenser
- .8 Pump
- .9 PRV
- .10 Control valve
- .11 Other equipment causing changes in conditions
- .12 At controllers
- .13 Controlled device

.8 Locations of systems measurements to include, but not limited to, following as appropriate: supply and return of primary and secondary loops (main, main branch, branch, sub-branch) of all hydronic systems, inlet connection of make-up water.

1.21 DOMESTIC WATER SYSTEMS

.1 Meet requirements as specified for hydronic systems.

.2 Locations of equipment measurements: to include, but not limited to, following as appropriate: inlet and outlet heaters, tank, pump, circulator, at controllers, controlled device.

.3 Locations of systems measurements to include, but not limited to, following as appropriate: main, main branch, branch, sub-branch.

1.22 OTHER SYSTEMS

.1 Plumbing systems:
- .1 Standard: National Plumbing Code.
- .2 TAB procedures:
  - .1 Flush valves: adjust to suit project pressure conditions.
  - .2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.
  - .3 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.
  - .4 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.
  - .5 Pressure reducing station.

.2 Wet pipe sprinkler systems:
- .1 Standard: NFPA.
- .2 TAB procedures: Refer to NFPA 13 Sprinkler System.

.3 Refrigeration systems forming part of HVAC systems:
- .1 Standard: CSA B52 - Mechanical Refrigeration Code.
- .2 TAB procedures: Refer to Standard as follows:
  - .1 Suction Pressure and Temperature.
  - .2 Discharge Pressure and Temperature.
  - .3 Suction Superheat.
  - .4 Evaporation Pressure and Temperature.

.4 Chemical treatment systems:
- .1 Standard: Section 23 25 00 - HVAC Water Treatment Systems.
- .2 TAB procedures: refer to Section 23 25 00 - HVAC Water Treatment Systems.

1.23 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.
.2 Quality assurance: as for air systems specified this section.

.2 Building pressure conditions:
.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter and summer design conditions.

.3 Zone pressure differences:
.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.

.4 Smoke management systems:
.1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air system specified in other Divisions.

.5 Measurement of noise and vibration from equipment specified in Mechanical Division.
.1 Standard: Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment and Section 23 32 48 - Acoustical Air Plenums.
.2 Vibration measurements around each piece of rotating equipment.
.3 Sound measurements in each octave band around each piece of rotating equipment.
.4 Induct sound measurements in each octave band at each fan inlet and discharge.
.5 Induct sound measurements in each octave band at each air handling unit intake, return and discharge.
.6 Sound measurements in each octave band for each normal occupied room with air handling equipment running.

.6 Measurement of spatial noise:
.1 Standard: Section 23 32 48 - Acoustical Air Plenums.

1.24 POST-OCCUPANCY TAB

.1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of areas designated by Owner's Representative.

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 3 months of termination of Warranty Period.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- .1 SMACNA HVAC Air Duct Leakage Test Manual.

1.3 SUBMITTALS

.1 Make submittals in accordance with Division 01 - General Requirements.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
- .1 Submit proposed report form and test report format to Consultant for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Consultant.
- .2 Prepare report of results and submit to Consultant within 24 hours of completion of tests. Include:
  - .1 Schematic of entire system.
  - .2 Schematic of section under test showing test site.
  - .3 Required and achieved static pressures.
  - .4 Orifice differential pressure at test sites.
  - .5 Permissible and actual leakage flow rate (L/s) for test sites.
  - .6 Witnessed certification of results.
- .3 Include test reports in final TAB report.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

2 Products

2.1 TEST INSTRUMENTS

.1 Test apparatus to include:
- .1 Fan capable of producing required static pressure.
- .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
- .3 Flow measuring instrument compatible with the orifice plate.
- .4 Calibration curves for orifice plates used.
- .5 Flexible duct for connecting to ductwork under test.
- .6 Smoke bombs for visual inspections.

.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
.3 Submit details of test instruments to be used to Consultant at least three months before anticipated start date.
.4 Test instruments: calibrated and certificate of calibration deposited with Consultant no more than 28 days before start of tests.
.5 Re-calibrated every six months thereafter.

2.2 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and System Components such as VAV Boxes, Duct Heating Leakage: 2%

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
.2 Section of duct to be tested to include:
  .1 Fittings, branch ducts, tap-ins.
.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
.2 Leakage tests on following systems not to exceed specified leakage rates.
  .1 Small duct systems up to 250 Pa: leakage 2%.
  .2 VAV box and duct on downstream side of VAV box: leakage 2%.
  .3 Large low pressure duct systems up to 500 Pa: leakage 2%.
  .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1%.
.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TIMING OF TESTING

.1 Test ducts before installation of insulation or other forms of concealment.
.2 Test after seals have cured.
.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

3.5 EXCLUSIONS

.1 Flexible connections to VAV boxes.

3.6 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services.
  .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed:

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

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

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

.4 Obtain reports, within 3 days of review, and submit, immediately, to Consultant.

.2 Performance Verification:

.1 Consultant to witness tests and to verify reported results.

.2 To be certified by same TAB agency approved by Consultant to undertake TAB on this project.

3.7 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ANSI/ASHRAE/IESNA 90.1-, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)
- .1 ASTM B209M-, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C335-, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411-, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M-, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547-, Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .9 ASTM C921-, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma-, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701-, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.3 DEFINITIONS

.1 For purposes of this section:
- .1 "CONCEALED" - means any work which is installed in suspended ceilings (accessible or non-accessible), attics and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - means any work which is not concealed in walls, shafts, or above accessible or non-accessible ceilings. Work behind doors, in closets, in cupboards, or under counters is considered exposed.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
- .1 CRD: Commercial Round Ductwork,
- .2 CRF: Commercial Rectangular Finish,
- .3 CEF: Commercial Rigid Insulation External Application.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Division 01 - General Requirements.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 SAMPLES

.1 Submit samples in accordance with Division 01 - General Requirements.
.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.6 MANUFACTURERS' INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Division 01 - General Requirements.
.2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to TIAC standards.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
.2 Protect from weather and construction traffic.
.3 Protect against damage from any source.
.4 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
.4 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.
.5 Divert unused adhesive material from landfill to official hazardous material collections site approved by Consultant.
.6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:
  .1 Maximum flame spread rating: 25.
  .2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
  .1 .1 Acceptable material: Knauf Fiberglass Insulation Board with FSK Facing , John Manville 814 Spin-Glas, Mason AK Board FSK, Owens Corning, Certainteed & Roxul or equal.

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
- .1 Mineral fibre: to ASTM C553.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to ASTM C553.
- .4 Acceptable materials: Knauf Fiberglass Blanket FSK Ductwrap Type lll, John Manville Microlite, FSK Ductwrap Type 150, Certainteed, Manson, Roxul, Owens Corning or equal.

2.3 JACKETS

.1 Canvas:
- .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum:
- .1 To ASTM B209 with moisture barrier as per attached Ductwork Insulation Schedule.
- .2 Thickness: 0.40 mm sheet.
- .3 Finish: Smooth.
- .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

.4 Stainless steel:
- .1 Type: 304.
- .2 Thickness: 0.25 mm sheet.
- .3 Finish: Smooth.
- .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
- .1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
- .1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:
- .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:
- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

.6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.

.12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

.13 Self-adhesive weather barrier membrane shall be installed over all fasteners and joints for a zero leakage system.

.14 Acceptable material:
- .1 Bakor Foil-skin, 3 M Venture clad or equal.

3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.
.2 Apply materials in accordance with manufacturers instructions and as indicated.
.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  .1 Hangers, supports to be outside vapour retarder jacket.
.5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thickness: Conform to following Table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts (exposed)	CER/2	yes	50
Round cold and dual temperature supply air ducts (concealed)	CEF/2	yes	50
Rectangular warm air ducts (exposed)	CER/1	no	25
Round warm air ducts (exposed)	CER/1	no	25
Rectangular cold and dual temperature supply air ducts (concealed)	CEF/2	yes	50
Round cold and dual temperature supply air ducts (exposed)	CER/2	yes	50
Rectangular warm air ducts (concealed)	CEF/1	no	25
Round warm air ducts (concealed)	CEF/1	no	25
Outside air ducts to mixing plenum	CER/2	yes	50
Mixing Plemums	CER/2	yes	25
Exhaust duct between dampers and louvers	CER/2	yes	50
Rectangular ducts outside	CER/3	special	50
Round ducts outside	CRD/3	special	50
Acoustically lined ducts	See Section 23 33 53 - Duct Liners		
Exterior Ductwork	C-1	special	125

  .1 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
    .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.2 Finishes: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	None	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3

	TIAC Code	
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5
Production Space:	Stainless Steel Jacket.	

3.4 APPLICATION

.1 Rigid Insulation External Application:
- .1 CER/1 Hot Duct and Plenum (20° to 65°C):
  - .1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers, each direction.
  - .2 Application: Cut insulation without integral vapour retarder to required size and apply to exterior of duct and/or plenum, with horizontal surfaces overlapping vertical surfaces and edges tightly butted together. Secure insulation by impaling on mechanical fasteners. (See Note 1)
- .2 CER/2 Cold or Dual Temp Duct and Plenum (Sub-ambient to 65°C):
  - .1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm on centers, each direction.
  - .2 Application: Cut insulation with integral vapour retarder to required size
    - .1 and apply to exterior of duct and/or plenum with vapour retarder to the warm side with horizontal surfaces overlapping vertical surfaces. Butt edges together tightly. Secure insulation by impaling on mechanical fasteners. Where mechanical fasteners penetrate vapour retarder, and at all corners and joints, apply self adhesive vapour retarder tape or vapour retarder strips adhered with vapour retarder adhesive. Where raised seams are encountered, add a strip of insulation above seam termination on each side of the seam, secure to the seams an overlapping strip of insulating material of equal thickness to the one required with integral vapour retarder to provide a continuous vapour retarder and seal all joints and edges with self adhesive vapour retarder tape. (See Note 1)
- .3 CER/3 Outside Air Duct and Plenum (-40°C to Ambient):
  - .1 As CER/2 above but firstly apply a layer of rigid insulation without vapour retarder before applying layer of rigid insulation with vapour retarder. All joints shall be staggered.
- .4 Note 1:
  - .1 For external applications of rigid insulation (CER/1 and CER/2) where the use of mechanical fasteners is unsuitable due to space limitations, wire fastenings, insulation adhesive or other suitable method of attachment may be substituted.
- .5 Note 2:
  - .1 Except where specifically called for in the Insulation section of the project specifications, where an interior duct liner is used, external insulation shall not be applied.

.2 Flexible Insulation External Application:
- .1 CEF/1 Hot Duct and Plenum (20°C to 65°C):
  - .1 Preparation: On round ducts and on rectangular ducts 740mm or less in width, no preparation is necessary. On rectangular ducts 600mm or more in width, apply to bottom surface, either mechanical fasteners at approximately 300 mm centres, or insulation adhesive applied in strips 100mm wide on approximately 300 mm centres.

.2 Application: Cut insulation without integral vapour retarder to required size allowing for 50 mm overlap at each joint and apply to exterior of duct. Secure insulation with either twine or wire fastening on approximately 300 mm centres, or by stapling laps; or by 100% insulation adhesive coverage.

.2 CEF/2 Cold or Dual Temp Duct and Plenum (Sub-ambient to 65°C):

.1 Preparation: On rectangular ducts 600 mm or more in width, apply to bottom surface, either mechanical fasteners at approximately 300 mm centers or insulation adhesive in strips 100 mm wide on approximately 300 mm centers.

.2 Application: Cut insulation with integral vapour retarder to required size and apply to exterior or duct with vapour retarder to the outside. Where mechanical fasteners or staples penetrate the vapour retarder and at all joints apply vapour retarder tape or vapour retarder strips adhered with vapour retarder adhesive. All joints shall be overlapped a minimum of 50 mm and stapled on approximately 100 mm centers. Secure insulation with wire fastening on approximately 300 mm centers. (See Notes 1 and 2)

.3 Note 1:

.1 Except where specifically called for in the Insulation section of the project specifications, where aninterior duct liner is used, external insulation shall not be applied.

.4 Note 2:

.1 All Outside Air Ducts shall be insulated as specified under CER/3, Page CD-1.

.3 Liner Internal Application:

.1 CIR/1 Rigid Duct Liner:

.1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers each direction.

.2 Application: Cut insulation material to required size and apply to interior of duct and/or plenum with horizontal surfaces overlapping vertical surfaces and with edges tightly butted together. Insulation shall be applied to the ductwork with a minimum 90% coverage of adhesive and mechanical fasteners. Where mechanical fasteners penetrate factory finish and at all joints, apply a heavy layer of seal coating. On high velocity duct systems 20.32m/s to 30.48 m/s apply reinforcing membrane over the entire insulation joint surface. Seal off leading edge of insulation to duct surface with reinforced seal coating. (See Note 1)

.2 CIF/1 Flexible Duct Liner:

.1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers each way.

.2 Application: Cut insulation material to required size and apply to interior of duct, edges tightly butted together. Insulation shall be applied to the ductwork with a minimum 90% coverage of adhesive and mechanical fasteners. Where mechanical fasteners penetrate factory finish and at all joints, apply a heavy layer of seal coating. On duct systems having a

.1 m/s to 20.32 m/s velocity, reinforce the joints with seal coating and reinforcing membrane. Seal off leading edge of insulation to duct surface with reinforced seal coating. (See Note 1)

.3 Note 1:

.1 Except where specifically called for in the Insulation section of the project specifications, where an interior duct liner is used, external insulation shall not be applied.

.4 Note 2:

.1 Internal insulation shall not be applied to duct work that is below ambient temperature.

3.5 FINISHES

.1 Rectangular Ducts:
- .1 CRF/1 Indoor:
  - .1 Use over rigid insulation with an integral vapour retarder vapour. Apply continuous metal corner bead to all corners. Adhere vapour retarder tape over all joints and breaks in vapour retarder, and at all corners.
  - .2 Secure canvas jacket over insulation using fire resistive lagging coating and adhesive, and finish with one (1) coat of fire resistive lagging coating adhesive.
- .2 CRF/2 Indoor:
  - .1 Use over rigid insulation with an integral vapour retarder. Apply continuous metal corner bead to all corners. Adhere vapour retarder tape over all joints and breaks in vapour retarder, and at all corners.
- .3 CRF/3 Outdoor:
  - .1 Adhere vapour retarder tape over all joints and breaks in vapour retarder and at all corners on cold or dual temp ductwork.
  - .2 Apply over the insulation surface a stucco embossed aluminum jacket secured with pop rivets or stainless steel self tapping screws. All joints sealed or flashed to prevent water infiltration.
- .4 CRF/4 Outdoor:
  - .1 Apply to the insulation surface a coat (minimum 1 litre per 1.5 m) of weather coating. While still wet, embed a layer of reinforcing membrane and finish with a final coat (minimum 1 litre per 1.5 m) of weather coating. (Insulation having factory applied vapour retarder is not 2 required with this finish).
- .5 CRF/5 Outdoor:
  - .1 Install a modified bitumen membrane in accordance to manufacturer's instructions.

.2 Round Ducts:
- .1 CRD/1 Indoor:
  - .1 Use with flexible insulation or pipe and tank wrap with integral vapour retarder. At all joints and breaks, apply self-adhesive vapour retarder tape.
  - .2 Apply canvas jacket over insulation using fire resistive lagging coating and finish with one (1) coat of fire resistive lagging coating.
- .2 CRD/2 Indoor:
  - .1 Use flexible insulation with integral vapour retarder.
  - .2 At all joints and breaks, apply vapour retarder tape.
- .3 CRD/3 Outdoor:
  - .1 Adhere vapour retarder tape over all joints and breaks in vapour retarder on cold or dual temp ductwork.
  - .2 Apply over the insulation surface a stucco embossed aluminum jacket secured with pop rivets or stainless steel self-tapping screws. All joints sealed or flashed to prevent water infiltration.
- .4 CRD/4 Outdoor
  - .1 .1 Install an aluminized modified bitumen membrane in accordance to manufacturer's instructions.
- .5 CRD/5 Outdoor
  - .1 Apply to the insulation surface a coat (minimum 1 litre per 1.5 m) of weather coating. While still wet, embed a layer of reinforcing membrane and finish with a final coat (minimum 1 litre per 1.5 m) of weather coating.(Insulation having factory applied vapour retarder is not required with this finish).

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.2 Section 23 05 52 - Mechanical Identification.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  .1 ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
.2 American Society for Testing and Materials (ASTM International)
  .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  .4 ASTM C449/C449M, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  .5 ASTM C533, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  .6 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
  .7 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  .8 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
  .9 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  .10 ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
.3 Canadian General Standards Board (CGSB)
  .1 CGSB 51-GP-52Ma, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  .2 CGSB 51-GP-53M, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
.4 Thermal Insulation Association of Canada (TIAC)
  .1 National Insulation Standards.
.5 Underwriters Laboratories of Canada (ULC)
  .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
.6 National Energy Code of Canada for Buildings (NECB).

1.3 PRODUCT DATA

.1 Submit Product Data in accordance with Division 01 - General Requirements.

1.4 SAMPLES

.1 Submit samples in accordance with Division 01 - General Requirements.
.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Division 01 - General Requirements.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.6 QUALIFICATIONS

.1 Installer to be specialist in performing work of this section, and have at least three (3) years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
.2 Protect from weather and construction traffic.
.3 Protect against damage from any source.
.4 Store at temperatures and conditions recommended by manufacturer.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements
.2
.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.4 Collect and separate for disposal paper packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
.5 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.
.6 Divert unused adhesive materials from landfill to official hazardous material collections site approved by Consultant.
.7 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:
  .1 Maximum flame spread rating: 25.
  .2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.
.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
  .1 Mineral fibre: ASTM C547.
  .2 Maximum "k" factor: ASTM C547.
.4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
  .1 Mineral fibre: ASTM C547.
  .2 Jacket: to CGSB 1-GP-52Ma.
  .3 Maximum "k" factor: ASTM C547.
.5 TIAC Code C-1: Rigid mineral fibre board, unfaced.
  .1 Mineral fibre: ASTM C612.
  .2 Maximum "k" factor: ASTM C612.
.6 TIAC Code C-4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
  .1 Mineral fibre: ASTM C612.
  .2 Jacket: to CGSB51-GP-52Ma.
  .3 Maximum "k" factor: ASTM C612.
.7 TIAC Code C-2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: ASTM C553.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: ASTM C553.

.8 TIAC Code A.6: Flexible unicellular tubular elastomer.
.1 Insulation: with vapour retarder jacket.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor.
.4 Certified by manufacturer free of potential stress corrosion cracking corrodants.

.9 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
.1 Insulation: ASTM C533.
.2 Maximum "k" factor: ASTM C533.
.3 Design to permit periodic removal and re-installation.

2.3 CEMENT

.1 Thermal insulating and finish
.1 To: ASTM C449/C449M.
.2 Hydraulic setting on mineral wool, to ASTM C449.

2.4 JACKETS

.1 Polyvinyl Chloride (PVC):
.1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
.2 Colours: to match adjacent finish paint.
.3 Minimum service temperatures: -20°C.
.4 Maximum service temperature: 65°C.
.5 Moisture vapour transmission: 0.02 perm.
.6 Thickness: 0.56 mm.
.7 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.
.8 Special requirements:
.1 Indoor: Flame spread rating 25, smoke developed 50.
.2 Outdoor: UV rated material at least 0.5 mm thick.
.9 Covering adhesive: Compatible with insulation.

.2 ABS Plastic:
.1 One-piece moulded type and sheet with pre-formed shapes as required.
.2 Colours: to match adjacent finish paint.
.3 Minimum service temperatures: -40°C.
.4 Maximum service temperature: 82°C.
.5 Moisture vapour transmission: 0.012 perm.
.6 Thickness: 0.75 mm.
.7 Fastenings:
.1 Solvent weld adhesive compatible with insulation to seal laps and joints
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.
.8 Locations:
.1 For outdoor use ONLY.

.3 Canvas:
.1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: Compatible with insulation.

.4 Aluminum:

.1 To ASTM B209.
.2 Thickness: 0.50 mm sheet.
.3 Finish: Smooth.
.4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.5 Stainless steel:
.1 Type: 304 or 316.
.2 Thickness: 0.25 mm.
.3 Finish: Smooth.
.4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.5 REMOVABLE INSULATION COVERS

.1 General:
.1 All Covers shall be sewn, stapled or "hog-ringed" covers shall not be acceptable.
.2 Covers shall conform to the configuration of the items being insulated.
.3 Covers shall include openings for all protrusions such as pipes, packing glands on valves and expansion joints, hangers, supports, instrument lines, and other appurtenances.
.4 Covers shall be designed so that no force bending or folding of the cover is necessary for installation.
.5 Minimum 50 mm wide flaps at terminal ends are to be provided to overlap adjacent covers to ensure a good heat seal.
.6 Parting seems shall be at the installed low points (gravitational bottom) of the cover to allow drainage without the use of weep tubes or grommets.
.7 Valve bonnets are to be covered, but packing glands shall remain exposed.
.8 Valve covers are to be designed such that the bonnet section is sewn to the body section. For larger valves, the cover may be fabricated in two sections, each section containing one half of the valve body bonnet.
.9 Covers with a weight of 18.1 Kg or less are to be fabricated in one piece.
.10 Covers with a weight of more than 18.1 Kg are to be fabricated in more than one piece.

.2 Insulation Core:
.1 The insulation core shall be fabricated in one piece, wherever possible.
.2 To prevent insulation settlement, the insulation core shall be secured within the jacket through the weather barrier (outer jacketing), the insulation, and the liner (inner jacketing).
.3 Insulating cores with more than one piece shall have staggered joints to prevent hot spots and heat loss. The joint edges shall be butted together and extra securement provided at those edges.
.4 Insulation core shall be comprised of 50 mm thick fiberglass insulation of non-combustible wool with resilient inorganic glass fibers bonded with a thermosetting resin. Insulation density to be 38 Kg/m3. Insulation thermal conductivity to be 0.044W/m. deg C at a mean temperature of 100 deg C.

.3 Jacket:
.1 The jacket shall be fabricated in one piece, wherever possible.
.2 Gusset walls shall be required for covers with core insulation thickness in excess of 25 mm.

.3 All seams, except the final closing seam, shall be inside seams. The jackets are to be sewn inside out, then turned correct side out before inserting the insulation core. The final closing seam shall be sewn on the exterior of the jacket. Seams shall be sewn with Teflon coated fiberglass thread or Kevlar coated stainless steel thread.
.4 Machine stitching shall be used for all sewing. Sewing shall be 6-8 stitches per centimeter.
.5 Draw cords are to be placed along the outer edge of the flap and the outer edge of the flap then rolled back inside and double stitched.
.6 Draw cords are to be of sufficient length to allow 150 mm of cords to protrude from each side of the flap.
.7 The inner and outer jacket shall be comprised of a fiberglass fabric impregnated with silicone rubber. The silicone rubber shall be flame retardant and suitable for high temperature usage. Outer jacket density shall be 595 gms/m2.

.4 Securement devices:
.1 The securement belts and D-ring belts shall be of the same material as the weather barrier (exterior jacket).
.2 The belts shall be placed 50 mm back from the parting seams and on 150 mm centers.
.3 Fire retardant Velcro shall be used to fasten the securement belt to the weather barrier after the belt passed through the Stainless Steel D-rings.

.5 Identification tags:
.1 Each cover shall be identified by a permanently attached stainless steel tag.
.2 An identification legend shall be mechanically embossed into the tag.
.3 The tags shall be located in the same areas on similar type covers.
.4 Should a cover require more than one piece for its construction, each piece to be identified and numbered (i.e. 1 or 3)
.5 Each tag shall include at least the following information, but may also include any pertinent information required by the end user.
.1 Type of item being covered.
.2 Location of item.
.3 Recording and tracking information.

.6 Warranty:
.1 Provide a 5-year product Warranty

.7 Acceptable material:
.1 Advanced Industrial Systems Inc., Thermo Help Canada Inc., Advanced Thermal Corp., Island Thermal Innovations.

2.6 INSULATION SECUREMENTS

.1 Tape: Self-adhesive, aluminum, plain, 50 mm wide minimum.
.2 Contact adhesive: Quick setting.
.3 Canvas adhesive: Washable.
.4 Tie wire: 1.5 mm diameter stainless steel.
.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
.6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation.
.7 Fasteners: 2 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

2.7 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.8 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.9 OUTDOOR VAPOUR RETARDER MASTIC

.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m2.

3 Execution

3.1 PRE- INSTALLATION REQUIREMENTS

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.
.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards
  .1 Hot equipment: To TIAC code 1503-H.
  .2 Cold equipment: to TIAC code 1503-C or 1503-CA.
.2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
.3 Provide vapour retarder as recommended by manufacturer.
.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  .1 Hangers, supports outside vapour retarder jacket.
.7 Supports, Hangers:
  .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 EQUIPMENT INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
.2 Hot Equipment:
  .1 TIAC code A-1 or C-1 mechanical fastenings or wire or bands and 13 cement reinforced with one layer of reinforcing mesh.
  .2 TIAC code A-2 with 25 mm air gap, mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
  .3 TIAC code C-2 unfaced with wire and 13 mm cement precede by one layer of reinforcing mesh.
  .4 Thicknesses:
    .1 Domestic hot water storage tanks: 50mm.
    .2 Air Separators: 50mm.
    .3 Heat exchangers: 50mm (shell tube and plate exchangers)
    .4 Steam condensate receivers: 50mm
    .5 Dearator-feedwater heaters: 50mm
    .6 Expansion tanks: 50mm
    .7 Hot water buffer tanks: 50mm.
.3 Breechings, engine exhausts and mufflers:
  .1 TIAC code A-2 with 25 mm air gap, mechanical fastenings and 13 mm cement reinforced with one layer of reinforcing mesh.
.4 Cold equipment:
  .1 TIAC A-3 or C-4 with mechanical fastenings, wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
  .2 TIAC C-2 faced with vapour retardant jacket with wire or bands and 13mm cement preceded by one layer of reinforcing mesh.
  .3 TIAC A-6 or C-4 with mechanical fastenings, wire, bands or adhesive.

.4 Thicknesses:
- .1 Chillers (except factory insulated): A-3, A-6 or C-4, 50 mm.
- .2 Expansion tanks: A-3, A-6 or C-4, 50mm
- .3 Air Separators: A-3, A-6 or C-4, 50mm
- .4 Heat exchangers (shell tube and plate): A-3, A-6 or C-4, 50mm.
- .5 Chilled water buffer tanks: A-3, A-6 or C-4, 50 mm.

.5 Finishes:
- .1 Engine exhaust piping and muffler: To TIAC code CRF-4.
- .2 Equipment in mechanical rooms: TIAC code CEF/1 with aluminum jacket.
- .3 Equipment elsewhere: TIAC code CEF/2 with 13 mm cement jacket.

3.4 REMOVABLE INSULATION COVERS

.1 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.2 Removable insulation covers shall be provided for the following:
- .1 Domestic water service entrance backflow preventer.
- .2 Domestic water service entrance pressure reducing valve assembly.
- .3 Domestic water service entrance O.S. & Y gate valve.
- .4 Domestic water service entrance copper connection butterfly valves NPS 2 1/2 and larger.
- .5 Domestic water service entrance wye - strainer.
- .6 Domestic hot water service pump assemblies.
- .7 Hydronic heating and chilled water system pump assemblies; - pumps, suction diffusers, triple duty valves.
- .8 Hydronic heating and chilled water system valves NPS 2 1/2 and larger -gate, globe and butterfly.
- .9 Hydronic heating and chilled water system flex connections, expansion joints.
- .10 Hydronic heating and chilled water system expansion tanks.
- .11 Hydronic heating and chilled water system air separators.
- .12 Hydronic heating and chilled water system plate and frame heat exchangers.
- .13 Hydronic heating and chilled water system shell and tube heat exchangers removable heads.
- .14 Balancing valves NPS 2 1/2 and above.
- .15 Two-Way Control valves NPS 2 1/2 and larger.
- .16 Three-Way Control valves NPS 2 1/2 and larger.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 22 11 18 - Domestic Water Piping Copper & PEX.
.2 Section 22 42 01 - Plumbing Specialties and Accessories.
.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
.5 Section 23 11 13 - Facility Fuel-oil Piping.
.6 Section 23 21 13 - Hydronic Systems: Steel.
.7 Section 23 23 00 - Copper Tubing and Fittings Refrigerant.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
  .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
.2 When systems are operational, perform following tests:
  .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  .2 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    .1 Pump operation.
    .2 Boiler and/or chiller operation.
    .3 Pressure bypass open/closed.
    .4 Control pressure failure.
    .5 Maximum heating demand.
    .6 Maximum cooling demand.
    .7 Boiler and/or chiller failure.
    .8 Cooling tower (and/or industrial fluid cooler) fan failure.
    .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:
  .1 TAB has been completed
  .2 Verification of operating, limit, safety controls.
  .3 Verification of primary and secondary pump flow rates.
  .4 Verification of accuracy of temperature and pressure sensors and gauges.
.2 Calculate system capacity at test conditions.
.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or

.2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heat exchanger, heating coil and radiation control valves.

.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

.3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

.7 Chilled water system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Adding heat from building heating system or;

.2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater that OAT. RAT to be at least 23 degrees C minimum.

.2 Test procedures:

.1 Open fully cooling coil control valves.

.2 Set thermostats on associated AHU's for maximum cooling.

.3 Set AHU's for design maximum air flow rates.

.4 Set load or demand limiters on chillers to 100%.

.5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

1.6 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 23.

.2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

1.7 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.

.2 Verification of controls, detection devices, alarm devices is specified Division 26.

.3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.

.4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.8 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.
.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
.5 Cleanouts: refer to Section 22 42 01 - Plumbing Specialties And Accessories
.6 Roof drains:
  .1 Refer to Section 22 42 01 - Plumbing Specialties And Accessories
  .2 Remove caps as required.

1.9 REPORTS

.1 In accordance with Division 01 - General Requirements, supplemented as specified herein.

1.10 TRAINING

.1 In accordance with Division 01 - General Requirements, supplemented as specified herein.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section includes:
- .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 RELATED SECTIONS

.1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.2 Section 23 25 00 - HVAC Water Treatment Systems.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
- .1 Instructions: submit manufacturer's installation instructions.
  - .1 Consultant will make available one (1) copy of systems supplier's installation instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 - General Requirements.

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

2 Products

2.1 CLEANING SOLUTIONS

.1 Low-foaming detergent: at all temperatures.
.2 Designed for use on most metals including aluminum.
.3 No pH neutralization required.
.4 Phosphate free.
.5 Biodegradable.
.6 Nitrate Free.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 CLEANING HYDRONIC AND STEAM SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Flush system thoroughly with water, back flush pump, strainers, blow down drain valves and risers to remove loose debris. Remove accumulated sludge in boilers.

.2 Add 2% solution of low foaming detergent to the system through a bypass feeder or another feeding device.

.3 Closed loop systems: circulate system cleaner at 820 degrees C for at least 36 hours. For chiller systems, circulate at least 48 hours at ambient temperature.

.4 During recirculation, back flush strainers, drain valves and risers at their lowest point once every 8 hours.

.5 Drain cleaning water completely.

.6 Fill and drain system several times. Circulate 30 minutes every time system is refilled.

.7 Blend system at secured points until water is clear and non foaming. Clean pump strainers.

.8 Draw a water sample from the system and send it to laboratory for analysis.

.9 If the laboratory report is unsatisfactory, repeat cleaning procedure.

.8 Steam Systems: in addition to general requirements as specified above, perform following:

.1 Remove internal components of steam traps until flushing and warm-up have been completed.

.2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.
.3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.
.4 Water hammer: determine source and eliminate cause.

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:
.1 Establish circulation and expansion tank level, set pressure controls.
.2 Ensure air is removed.
.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
.5 Clean out strainers repeatedly until system is clean.
.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
.8 Repeat with water at design temperature.
.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
.10 Bring system up to design temperature and pressure slowly over a 48 hour period.
.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.12 Adjust pipe supports, hangers, springs as necessary.
.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
.15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
.16 Check operation of drain valves.
.17 Adjust valve stem packings as systems settle down.
.18 Fully open balancing valves (except those that are factory-set).
.19 Check operation of over-temperature protection devices on circulating pumps.
.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.
.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 RELATED SECTIONS

.1 Section 07 92 00 - Joint Sealants.
.2 Section 23 05 54 - Mechanical Identification.
.3 Section 23 07 14 - Thermal Insulation for Equipment.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
- .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.
- .6 ASTM C547, Mineral Fiber Pipe Insulation.
- .7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .9 ASTM D184, Standard Specification for Rigid Poly (Vinyl Chloride) (PUC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Trade Associations
- .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.6 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.
- .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

.7 National Energy Code of Canada for Buildings (NECB).

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:
.1 CRF: Code Rectangular Finish.
.2 CPF: Code Piping Finish.

1.5 SUBMITTALS

.1 Submittals: in accordance with Division 01 - General Requirements.
.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.
.3 Shop Drawings:
.1 Submit shop drawings in accordance with Division 01 - General Requirements.
.4 Samples:
.1 Submit samples in accordance with Division 01 - General Requirements.
.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
.5 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
.1 Certificates: submit certificates signed by manufacturer certifying thatmaterials comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions to Owner's Representative.

1.6 QUALITY ASSURANCE

.1 Qualifications:
.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 - General Requirements.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
.2 Storage and Protection:
.1 Protect from weather, construction traffic.
.2 Protect against damage.
.3 Store at temperatures and conditions required by manufacturer.
.3 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.
.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.
.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.
  .1 Maximum flame spread rating: 25.
  .2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  .1 Mineral fibre: to CAN/ULC-S702.
  .2 Maximum "k" factor: to CAN/ULC-S702.
.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  .1 Mineral fibre: to CAN/ULC-S702.
  .2 Jacket: to CGSB 51-GP-52Ma.
  .3 Maximum "k" factor: to CAN/ULC-S702.
.5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  .1 Mineral fibre: to CAN/ULC-S702.
  .2 Jacket: to CGSB 51-GP-52Ma.
  .3 Maximum "k" factor: to CAN/ULC-S702.
.6 TIAC Code A-6: flexible unicellular tubular elastomer.
  .1 Insulation: with vapour retarder jacket.
  .2 Jacket: to CGSB 51-GP-52Ma.
  .3 Maximum "k" factor: 0.039 w/m - °C
  .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
  .1 Insulation: to ASTM C533.
  .2 Maximum "k" factor: to 0.75 w/m °C @ 500°c.
  .3 Design to permit periodic removal and re-installation.
.8 TIAC Code A-4: extruded polystyrene pipe insulation in billets, sections, blocks and special shapes to suit project requirements.
  .1 Insulation: to ASTM C578, Type XIII.
  .2 Maximum 'K' factor to 0.037w/m °C @ 24°C.
  .3 2.0 perms/inch, closed call.
  .4 Note: exterior exposed piping only.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
.2 Contact adhesive: quick setting.
.3 Canvas adhesive: washable.
.4 Tie wire: 1.5 mm diameter stainless steel.
.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:
- .1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: fibrous glass, untreated 305 g/m2.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):
- .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
- .2 Colours: to match adjacent finish paint.
- .3 Minimum service temperatures: -20°C.
- .4 Maximum service temperature: 65°C.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: 0.55 mm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
  - .1 Indoor: flame spread rating 25, smoke developed rating 50.
  - .2 Outdoor: UV rated material at least 0.5 mm thick.

.2 ABS Plastic:
- .1 One-piece moulded type and sheet with pre-formed shapes as required.
- .2 Colours: to match adjacent finish paint.
- .3 Minimum service temperatures: -40°C.
- .4 Maximum service temperature: 82°C.
- .5 Moisture vapour transmission: 0.012 perm.
- .6 Thickness: 0.75 mm.
- .7 Fastenings:
  - .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Locations:
  - .1 For outdoor use ONLY.

.3 Canvas:
- .1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.

.4 Aluminum:
- .1 To ASTM B209.
- .2 Thickness: 0.50 mm sheet.
- .3 Finish: smooth.
- .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

.5 Stainless steel:
.1 Type: 304.
.2 Thickness: 0.25 mm.
.3 Finish: smooth.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Section 07 92 00 - Joint Sealants

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.
.2 Apply materials in accordance with manufacturers instructions and this specification.
.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Install hangers, supports outside vapour retarder jacket.
.5 Supports, Hangers:
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 See Section 23 07 14 - Thermal Insulation for Equipment.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
.2 TIAC Code: A-1.
.1 Securements: SS wire at 300 mm on centre.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code 1501-H.
.3 TIAC Code: A-3.
.1 Securements: SS wire at 300 mm on centre.
.2 Seals: VR lap seal adhesive, VR lagging adhesive.
.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.
- .1 Insulation securements: as per manufacturer's recommendation.
- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code: 1501-CA.

.5 TIAC Code: C-2 vapour retarder jacket.
- .1 Insulation securements: 18 ga SS wire, or 12mm x 0.5mm SS bands at 300mm o.c.
- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code: 1501-C.

.6 TIAC Code: A-2.
- .1 Insulation securements: 18 ga SS wire, or 12mm x 0.5mm SS bands at 300mm o.c.
- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code: 1501-H.

.7 Thickness of insulation as listed in following table.
- .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
- .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

APPLICATION	***Temp °C***	***TIAC Code***	***Run Out***	***To 1***	***$1^{1/4}$ to 2***	***$2^{1/2}$ to 4***	***5 to 6***	***8 & over***
			Pipe Sizes (NPS) & Insul. Thickness (mm)					
Steam	Up to 175	A-1	38	75	100	100	115	115
Steam, Saturated and Super heated	Over 175	A-1	38	114	127	127	127	127
Condensate Return	60-94	A-1	25	38	50	50	50	50
Pumped Condensate Return	Up to 94	A-1	25	38	50	50	50	50
Boiler Feed Water	--	A-1	25	38	50	50	50	50
Hot Water Heating	60-94	A-1	25	38	50	50	50	50
Hot Water Heating	Up to 59	A-1	25	25	38	38	38	38
Glycol Heating	60-94	A-1	25	38	50	50	50	50
Glycol Heating	Up to 59	A-1	25	25	38	38	38	38
Domestic HWS	--	A-1	25	38	25	38	38	38
Chilled Water	4-13	A-3	25	25	25	25	25	25
Chilled Water or Glycol	Below 4	A-3	25	25	38	38	38	38
Dual Temp. Heating	--	A-3	--	--	--	--	--	--
Dual Temp. Cooling	--	A-3	--	--	--	--	--	--
Chilled Water Pump Casing	--	A-3	25	25	25	25	25	25
Condenser Water Outdoors	--	--	--	--	--	--	--	--
Condenser Water Indoors	--	--	--	--	--	--	--	--
Refrigerated Drinking Water	--	A-3	25	25	25	25	25	25
Domestic CWS	--	A-3	25	25	25	25	25	25
Domestic CWS with Vapour Retarder	--	C-2	25	25	25	25	25	25

APPLICATION	***Temp °C***	***TIAC Code***	***Run Out***	***To 1***	***$1^{1/4}$ to 2***	***$2^{1/2}$ to 4***	***5 to 6***	***8 & over***
Refrigerant Hot Gas	4-13	A-6	25	25	25	25	25	25
Refrigerant Hot Gas	Below 4	A-6	25	25	38	38	38	38
RWL and RWP *	--	C-2	25	25	25	25	25	25
	* Note: All RWL and RWP leaders under loading dock ceiling to be insulation type A-4 with Aluminum Jacket and vapour retarder jacket. Heat Trace by electrical							
Cooling Coil Cond. Drain	--	C-2	25	25	25	25	25	25
Diesel Generator Exhaust System	--	A-2	38	65	65	75	90	90
Sanitary Outdoor Leaders and U/S of Deck **	--	A-4	25	25	25	25	25	25
	** Note: Heat Trace by Electrical, provide vapour retarder jacket and aluminum jacket.							

.8 Finishes:
- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: water-proof aluminum jacket or stainless steel jacket.
- .6 Finish attachments: SS screws, at 150 mm on centre. Seals: wing or closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section includes:
- .1 The supply and installation of hydronic specialties equipment.

1.2 RELATED SECTIONS

.1 Section 23 05 01 - Installation of Pipework.
.2 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME, Boiler and Pressure Vessel Code.

.2 American Society for Testing and Materials, (ASTM).
- .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
- .3 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
- .4 ASTM A536, Specification for Ductile Iron Castings.
- .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International).
- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.4 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.
.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.
- .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
- .2 Indicate on product data expansion tanks, air vents, separators, valves and strainers.

.3 Closeout Submittals:
- .1 Submit maintenance data in accordance with Division 01 - General Requirements.

1.5 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.6 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:
- .1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
- .2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

2 Products

2.1 CANADIAN REGISTRATION NUMBER (CRN)

.1 Required on all products as per Provincial Regulations and CSA B51.

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 1000 kPa working pressure.
.2 Industrial float vent: ASTM A48 Class 30, cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.
.3 Float: solid material suitable for 115 degrees C working temperature.

2.3 SUCTION DIFFUSER

.1 Body: cast iron with flanged or grooved ductile iron connections. 2.1 mPa.
.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 connection.
.3 Permanent magnet particle trap.
.4 Full length straightening vanes.
.5 Pressure gauge tappings.
.6 Adjustable support leg.
.7 Acceptable Material: Bell and Gossett, Victaulic, Taco, Armstrong.

2.4 TRIPLE DUTY VALVE

.1 Centre-guided non-slam drip tight check valve.
.2 Positive shut off valve.
.3 Calibrated system balancing valve.
.4 Straight pattern as indicated.
.5 Flanged or grooved end connections.
.6 Soft seat design for positive sealing.
.7 Construction:
  .1 Body: cast iron with bronze seat.
  .2 Disc: bronze with EPDM seat insert.
  .3 Stem: stainless steel.
  .4 Spring: stainless steel.
  .5 Packing: Teflon - graphite (asbestos free).
  .6 Gasket: asbestos free.
  .7 Readout Valve: brass with EPT insert, check valve and gasket.
  .8 Maximum operating temperature 121 C.
  .9 Maximum hourly pressure: 1.2 mPa.
  .10 Valve design shall permit repacking under full system pressure.
  .11 Provide complete with brass readout valves, integral check feature, to facilitate taking differential pressure readings across the orifice for accurate system balance.
  .12 Provide CU rating at 10% increments. Manufacturer shall supply the CU rating for readout of flow determination and system pressure drop.
  .13 Capacity: see schedule on drawings for performance criteria and model selection.
  .14 Acceptable Material: Bell and Gossett, Victaulic, Taco, Armstrong.

3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.
.2 Run drain lines and blow off connections to terminate above nearest drain.
.3 Maintain proper clearance to permit service and maintenance.
.4 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.
.2 Ensure clearance for removal of basket.
.3 Install ahead of each pump.
.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.3 AIR VENTS

.1 Install at high points of systems in piping mains. The Contractor shall provide automatic air eliminators in order to avoid air pockets in the system. Air vents are to be installed at an accessible place with the aid of necessary piping in order to facilitate maintenance.
.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.4 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50.

3.5 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.

END OF SECTION

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1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)
- .1 ANSI/AWS A5.8/A5.8M, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B16.4, Gray-Iron Threaded Fittings.
- .2 ANSI/ASME B16.15, Cast Bronze Threaded Fittings.
- .3 ANSI B16.18, Cast Copper Alloy, Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.22, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials International (ASTM)
- .1 ASTM B32, Standard Specification for Solder Metal.
- .2 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
- .3 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .4 ASTM B88M, Standard Specification for Seamless Copper Water Tube Metric.
- .5 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.5 Manufacturers Standardization Society (MSS)
- .1 MSS SP67, Butterfly Valves.
- .2 MSS SP70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS SP71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS SP80, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS SP85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.

.2 Shop Drawings:
- .1 Submit shop drawings in accordance with Division 01 - General Requirements.
- .2 Indicate on manufacturers catalogue literature the following: VALVES.

.3 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
  - .1 Consultant will make available one (1) copy of systems supplier's installation instructions.

.4 Closeout Submittals:
- .1 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial/Territorial regulations.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.4 MAINTENANCE

.1 Extra Materials:
- .1 Furnish following spare parts:
  - .1 Valve seats: one for every ten valves, each size. Minimum one.
  - .2 Discs: one for every ten valves, each size. Minimum one.
  - .3 Stem packing: one for every ten valves, each size. Minimum one.
  - .4 Valve handles: two of each size.
  - .5 Gaskets for flanges: one for every ten flanges.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 - General Requirements.

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

2 Products

2.1 TUBING

.1 Type A hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
.3 Cast iron threaded fittings: to ANSI/ASME B16.4.
.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

.1 Brass or bronze: threaded.
.2 Cast iron: threaded.
.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.
.2 Silver solder BCUP: to ANSI/AWS A5.8.
.3 Brazing: as indicated.

2.5 VALVES

.1 Connections:
- .1 NPS 2 and smaller: ends for soldering.
- .2 NPS 2 1/2 and larger: grooved ends.

.2 Ball valves:
- .1 NPS 2 and under: as specified Section 23 05 22 - Valves - Bronze.

.3 Gate valves:
- .1 NPS 2 and under:
  - .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 22 - Valves - Bronze.
  - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.2 NPS 2 1/2 and over:
.1 Mechanical Rooms: stem, split wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
.2 Elsewhere: rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.

.4 Butterfly valves:
.1 NPS 2 1/2 and over: grooved ends: as specified Section 23 05 17 - Pipe Welding.

.5 Globe valves: application: throttling, flow control, emergency bypass:
.1 NPS 2 and under:
.1 Mechanical Rooms: with PFTE disc, as specified Section 23 05 22 - Valves - Bronze.
.2 Elsewhere: globe, with composition disc, as specified Section 23 05 22 - Valves - Bronze.
.2 NPS 2 1/2 and over:
.1 With composition disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.

.6 Balancing, for TAB:
.1 Sizes: calibrated balancing valves, as specified.
.2 NPS 2 and under:
.1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 22 - Valves - Bronze.
.2 Elsewhere: globe, with plug disc as specified Section 23 05 22 - Valves - Bronze.

.7 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.8 Bypass valves on globe valves NPS 8 and larger: NPS 3/4, globe, with PFTE disc as specified Section 23 05 22 - Valves - Bronze.

.9 Swing check valves:
.1 NPS 2 and under:
.1 Class 125, swing, with composition disc, as specified Section 23 05 22 - Valves - Bronze.
.2 NPS 2 1/2 and over:
.1 Grooved ends: as specified Section 23 05 23 - Valves - Cast Iron.

.10 Silent check valves:
.1 NPS 2 and under:
.1 As specified Section 23 05 22 - Valves - Bronze.
.2 NPS 2 1/2 and over:
.1 Grooved ends: as specified Section 23 05 23 - Valves - Cast Iron.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
.6 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.
.2 Install butterfly valves on chilled water and condenser water lines only.
.3 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
.4 Install globe valves for balancing and in by-pass around control valves as indicated.
.5 Install silent check valves on discharge of pumps, in vertical pipes with downward flow and as indicated.
.6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
.7 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms and mechanical equipment rooms.
.8 Install ball valves for glycol service.

3.4 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.
.2 Remove handwheel after installation and TAB is complete.
.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.5 FLUSHING AND CLEANING

.1 Flush and clean in presence of Consultant.
.2 Flush after pressure test for a minimum of 4h.
.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8h.
.4 Refill system with clean water. Circulate for at least 4h. Clean out strainer screens/baskets regularly. Then drain.
.5 Refill system with clean water. Circulate for at least 2h. Clean out strainer screens/baskets regularly. Then drain.
.6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
.7 Re-install strainer screens/baskets only after obtaining Consultant's approval.

3.6 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment as specified or glycol as required.

3.7 FIELD QUALITY CONTROL

.1 Testing:
  .1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical.
  .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.
.2 Balancing:
  .1 Balance water systems to within plus or minus 5% of design output.
  .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing For HVAC.
.3 Glycol Charging:
  .1 Provide mixing tank and positive displacement pump for glycol charging.
  .2 Retest for concentration to ASTM E202 after cleaning.
  .3 Provide report to Consultant.

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation for steel piping, valves, and fittings for hydronic systems in building service piping including:
  - .1 Hot water heating piping
  - .2 Chilled water piping
  - .3 Condenser water piping
  - .4 Makeup water piping
  - .5 Air vent piping
  - .6 Safety valve inlet and outlet piping

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.
.2 Section 23 05 17 - Pipe Welding.
.3 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
.4 Section 23 05 01 - Installation of Pipework.
.5 Section 23 05 22 - Valves - Bronze.
.6 Section 23 05 23 - Valves - Cast Iron.
.7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.8 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME B16.1-, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASME B16.3-, Malleable Iron Threaded Fittings.
- .3 ASME B16.5-, Pipe Flanges and Flanged Fittings.
- .4 ASME B16.9-, Factory-Made Wrought Buttwelding Fittings.
- .5 ASME B18.2.1-, Square and Hex Bolts and Screws (Inch Series).
- .6 ASME B18.2.2-, Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A47/A47M-, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A536-, Standard Specification for Ductile Iron Castings.
- .4 ASTM B61-, Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B62-, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E202-, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).
- .1 AWWA C111-, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).
- .1 CSA B242-, Groove and Shoulder Type Mechanical Pipe Couplings.
- .2 CAN/CSA W48-, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
- .1 MSS-SP-67-, Butterfly Valves.
- .2 MSS-SP-70-, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71-, Cast Iron Swing Check Valves Flanged and Threaded Ends.
- .4 MSS-SP-80-, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85-, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

.6 Province of Prince Edward Island Boiler and Pressure Vessel Act and Regulations.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Division 01 - General Requirements.
- .1 Product Data: for each type of the following:
  - .1 Pipe materials.
  - .2 Unions and flanges, including gaskets, nuts and bolts.
  - .3 Welding Fittings.
  - .4 Groove and joint couplings and fittings.
  - .5 Sleeves and packing.
  - .6 Pressure seal fittings.
  - .7 Valves: include flow and pressure drop curves based on manufacturers testing for calibrated-orifice balancing valves and automatic flow control valves.
  - .8 Air control devices.
  - .9 Chemical treatment.
  - .10 Hydronic specialties: submit schedule listing type, make, model and model number, size and service for all hydronic specialties.

.2 Closeout Submittals.
- .1 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements and include following:
  - .1 Special servicing requirements.

.3 Groove joint couplings and fittings to be indicated on product submittals and to be specifically identified with the applicable style or series designation.

.4 Grooved products manufacturer to supply on site tools and products for installation training.

.5 All groove products to be of one manufacturer.

.6 Groove products to have current CRN numbers.

1.5 QUALITY ASSURANCE

.1 Health and Safety.
- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.
- .1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

1.7 MAINTENANCE

.1 Extra Materials.
- .1 Provide following spare parts:
  - .1 Valve seats: one for every ten valves, each size. Minimum one.
  - .2 Discs: one for every ten valves, each size. Minimum one.
  - .3 Stem packing: one for every ten valves, each size. Minimum one.
  - .4 Valve handles: two of each size.
  - .5 Gaskets for flanges: one for every ten flanges.

2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
- .1 Up to NPS 2: Schedule 40.
- .2 NPS 2-1/2 and 10: Schedule 10.
- .3 NPS 12 and over, 10 mm wall thickness.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
.2 NPS2-1/2 and over: welding fittings and flanges to CAN/CSA W48.
.3 Roll grooved: standard coupling to CSA B242.
.4 Flexible couplings to CSA B242 to be used where noted on drawings and on elbows utilized on expansion joints.
.5 Flanges: plain ASME B16.1 or raised face, slip-on or weld neck to ASME B16.5.
.6 Orifice flanges: slip-on raised face, 2100 kPa.
.7 Flange gaskets: to AWWA C111.
.8 Pipe thread: taper.
.9 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
.10 Roll grooved coupling gaskets: type EPDM - 40% to 120 deg C for continuous operation using hot water, glycol water, chilled water or condenser water.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
.2 Pipe flanges and flanged fittings:
- .1 Cast iron: to ASME B16.1, Class 125.
- .2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.
.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M, ductile iron to ASTM A536.

2.4 VALVES

.1 Connections:
- .1 NPS2 and smaller: screwed ends.
- .2 NPS 21/2 and larger: grooved ends.

.2 Ball valves:
- .1 NPS 2 and under: as specified in Section 23 05 22 - Valves - Bronze.

.3 Gate valves: to MSS-SP-70:
- .1 NPS 2 and under:
  - .1 Mechanical Rooms : Class 125, rising stem, split wedge disc, as specified Section 23 05 22 - Valves - Bronze.
  - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.
- .2 NPS 21/2 and over:
  - .1 Mechanical Rooms: stem, split wedge disc, lead free trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.
  - .2 Elsewhere: rising stem, solid wedge disc, lead free trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.4 Butterfly valves: to MSS-SP-67:
- .1 NPS 21/2 and over: Lug type: as specified Section 23 05 26 - Butterfly Valves.

.5 Globe valves: to MSS-SP-80:
- .1 NPS2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 22 - Valves - Bronze.
.2 Elsewhere: Globe, with composition disc, as specified Section 23 05 22 - Valves - Bronze.
.2 NPS21/2 and over:
.1 With composition disc, lead free trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.7 Bypass valves on globe valves NPS 8 and larger: NPS 3/4, Globe, with PTFE disc as specified Section 23 05 22 - Valves - Bronze.

.8 Swing check valves: to MSS-SP-71.
.1 NPS2 and under:
.1 Class 125, swing, with composition disc, as specified Section 23 05 22 - Valves - Bronze.
.2 NPS21/2 and over:
.1 Grooved ends: as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.9 Silent check valves:
.1 NPS2 and under:
.1 As specified Section 23 05 22 - Valves - Bronze.
.2 NPS21/2 and over:
.1 Grooved ends: as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.10 Glycol:
.1 Ethylene glycol with inhibitors for corrosion control.
.2 Percentage volume as indicated.

.11 Combination balancing and shutoff valves NPS 2 and smaller.
.1 Body: brass, stainless steel, bronze or a metal ball or y-pattern.
.2 Seat: PTFE or a metal
.3 End connection: threaded or socket.
.4 Pressure gauge connections: integral seals for portable differential pressure meter.
.5 Handle style: digital hand wheel, with memory stop to retain set position.
.6 CWP rating: minimum 125 PSIG.
.7 Maximum operating temperature: 250 deg F.
.8 Acceptable material: Tour and Anderson, Xylem, Armstrong.

.12 Combination balancing and shut off valves NPS 2 1/2 and larger.
.1 Body: ductile icon or steel body, ball, plug or globe pattern with calibrated orifice or ventur:
.2 Stem Seals: EPPM 0-rings.
.3 Disc: Elassor carbon filled PTFE
.4 Seat: PTFE
.5 End connections: flanged or grooved.
.6 Pressure gauge connections: integral seal for portable differential meter.
.7 Handle style: digital hand wheel with memory stop to retain set position.
.8 CWP rating: minimum 125 PSIG.
.9 Maximum operating temperature: 250 deg F.
.10 Acceptable material: Xylem, Tour and Anderson, Armstrong.

3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 01 - Installation of Pipe Work.

.1 Install shutoff duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
.2 Install balancing valves at each branch connection to return main and return pipe of each heating or cooling terminal.

3.2 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.
.2 Remove handwheel after installation and when TAB is complete.
.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

.1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical. Minimum 1.5 times working pressure on 1000 KPa.
.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.
.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.
.2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
.2 Provide copies of test reports for commissioning manuals.

END OF SECTION

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1 General

1.1 SECTION INCLUDES

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
  .1 Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
.3 Canadian Standards Association (CSA International).
  .1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.
.4 National Electrical Manufacturers Association (NEMA).
  .1 NEMA MG 1, Motors and Generators.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.
.2 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
.4 Submit product data of pump curves for review showing point of operation. Including rated capacities, NPSHR, efficiency lined and BHP lines.
.5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
.6 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse in accordance Division 01 - General Requirements.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
.4 Separate for reuse and place in designated containers Steel waste in accordance with Waste Management Plan.
.5 Fold up metal banding, flatten and place in designated area for recycling.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Division 01 - General Requirements.
.2 Furnish following spare parts:
  .1 Mechanical seal for each pump.
  .2 Packing for each pump.
  .3 Set of gaskets for each pump.

2 Products

2.1 EQUIPMENT

.1 Do component selection and sizing to: CAN/CSA-B214.

2.2 IN-LINE WET ROTOR CIRCULATORS

.1 Pump body: Cast iron
.2 Impellor: Polypropylene (glass filled)
.3 Shaft: Stainless steel
.4 Bearings: Graphite
.5 Gasket material: EPDM
.6 Maximum fluid temperature: 110ºC
.7 Maximum working pressure: 1000 kPa
.8 Capacity: as indicated.
.9 Connections: union or flanged
.10 Acceptable Material: Bell & Gossett, Taco, Armstrong, Grundfos, Wilo.

3 Execution

3.1 INSTALLATION

.1 Do Work in accordance with CAN/CSA-B214.
.2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
.3 Base mounted type: supply templates for anchor bolt placement. Furnish anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer's recommended tolerance. Check oil level and lubricate.
.4 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
.5 Pipe drain tapping to floor drain.
.6 Install volute venting pet cock in accessible location.
.7 Check rotation prior to start-up.
.8 Install pressure gauge ball valves.

3.2 START-UP

.1 General
  .1 In accordance with Section 01 91 13 - General Commissioning Requirements; supplemented as specified herein.
  .2 In accordance with manufacturer's recommendations.
.2 Procedures:
  .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  .2 After starting pump, check for proper, safe operation.
  .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  .4 Check base for free-floating, no obstructions under base.
  .5 Run-in pumps for 12 continuous hours.
  .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  .7 Eliminate air from scroll casing.
  .8 Adjust water flow rate through water-cooled bearings.
  .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  .10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.
.12 Adjust pump shaft seals, stuffing boxes, glands.
.13 Measure pressure drop across strainer when clean and with flow rates as finally set.
.14 Replace seals if pump used to degrease system or if pump used for temporary heat.
.15 Verify lubricating oil levels.
.16 Verify pipe system has been flushed , cleaned and filled.
.17 Prime pump and verify correct rotation.
.18 Verify correctly sized motor overload devices are installed.
.19 Ensure strainer is free of debris prior to testing and balancing of the hydronic system.
.20 After 30 days of operation, perform a final cleaning of the strainers.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General
  .1 In accordance with Section 01 91 13 - General Commissioning Requirements, supplemented as specified herein.
  .2 In accordance with manufacturer's recommendations
.2 Exclusions:
  .1 This paragraph does not apply to small in-line circulators.
.3 Assumptions: these PV procedures assume that:
  .1 Manufacturer's performance curves are accurate.
  .2 Valves on pump suction and discharge provide tight shut-off.
.4 Net Positive Suction Head (NPSH):
  .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
  .2 Measure using procedures prescribed in the Standard.
  .3 Where procedures do not exist, discontinue PV, report to Consultant and await instructions.
.5 Multiple Pump Installations - Series and Parallel:
  .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
.7 Commissioning Reports: In accordance with Division 01 - General Requirements, supplemented as specified herein. Reports to include:
  .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
  .2 Report forms as specified Division 01 - General Requirements.
  .3 Pump performance curves (family of curves).

3.4 FIELD QUALITY CONTROL

.1 Commissioning:
  .1 Manufacturer to:
    .1 Certify installation.
    .2 Start up and commission installation per tests recommended by manufacturer under actual or simulated operating conditions, and provide full compliance with design and specified requirements. Tests to be performed simultaneously with the system of which each item is an integral part.
    .3 Demonstrate operation and maintenance.
  .2 Provide Consultant at least 24 hours notice prior to inspections, tests and demonstrations. Submit written report of inspections and test results.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

.1 Section 07 84 00 - Firestopping.
.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
.2 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).
.4 National Fire Protection Association (NFPA).
  .1 NFPA 90A, Standard for the installation of Air-Conditioning and Ventilation Systems.
  .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air- Conditioning Systems.
  .3 NFPA 96, Standard for ventilation control and fire protection of commercial cooling operations.
.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition and Addendum No. 1.
  .2 SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition.
  .3 IAQ Guideline for Occupied Buildings Under Construction, 1st Edition.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
  .1 Sealants.
  .2 Tape.
  .3 Proprietary Joints.

1.5 QUALITY ASSURANCE

.1 Certification of Ratings:
  .1 .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
.2 Health and Safety:
  .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.
.3 Indoor Air Quality (IAQ) Management Plan.
  .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan for construction and preoccupancy phases of building.

.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

.4 Installers to be certified journey person level in sheet metal works.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse in accordance with Division 01 – General Requirements.

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

.3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and place in designated containers Steel waste in accordance with Waste Management Plan.

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

.6 Handle and dispose of hazardous materials in accordance with Provincial regulations.

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

2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

MAX Pressure Pa	SMACNA Seal Class
1000	A
750	B
500	C
250	C
125	

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations, and connections made air tight with sealant and tape.

.2 Class B: Longitudinal seam transverse joints, and connections made air tight with sealant, type or combination thereof.

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

2.2 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: centreline radius: 1.5 times width of duct.

.2 Round: smooth radius or five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:
  .1 To 400 mm: with single thickness turning vanes.
  .2 Over 400 mm: with double thickness turning vanes.
.4 Branches:
  .1 Rectangular main and branch: with radius on branch 1.5 times width of duct or 45 degree entry on branch.
  .2 Round main and branch: enter main duct at 45 degrees with conical connection.
  .3 Provide volume control damper in branch duct near connection to main duct.
  .4 Main duct branches: with splitter damper.
.5 Transitions:
  .1 Diverging: 20 degrees maximum included angle.
  .2 Converging: 30 degrees maximum included angle.
.6 Offsets:
  .1 Full radiused elbows.
.7 Obstruction deflectors: maintain full cross-sectional area.
  .1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
.2 Thickness, fabrication and reinforcement: to SMACNA.
.3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    .1 Maximum size duct supported by strap hanger: 500.
    .2 Hanger configuration: to ASHRAE.
    .3 Angle Size(mm) Rod Size(mm)
    .4 Upper hanger attachments:
      .1 For concrete: manufactured concrete inserts.
      .2 For steel joist: manufactured joist clamp.
      .3 For steel beams: manufactured beam clamps.
      .4 Acceptable material: Myatt, Grinnel, Hunt.

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2410 and over	50 x 50 x 6	10

3 Execution

3.1 GENERAL

.1 Do work in accordance with, NFPA 90A & 90B, ASHRAE and SMACNA.
.2 Do not break continuity of insulation vapour barrier with hangers or rods.
  .1 Insulate strap hangers 100 mm beyond insulated duct.
.3 Support risers in accordance with SMACNA.
.4 Install breakaway joints in ductwork on sides of fire separation.
.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.
.2 Angle hangers: complete with locking nuts and washers.

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:
  .1 Dishwasher exhaust.
  .2 Fresh air intake.
  .3 Minimum 3000 mm from duct mounted humidifier in all directions.
  .4 As indicated.
.2 Form bottom of horizontal duct without longitudinal seams.
  .1 Solder joints of bottom and side sheets.
  .2 Seal other joints with duct sealer.
.3 Slope horizontal branch ductwork down towards fume hoods served.
  .1 Slope header ducts down toward risers.
.4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging to open funnel drain.

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

3.5 LEAKAGE TESTS AND COMMISSIONING

.1 Refer to Section 23 05 94 - Pressure testing of ducted air systems.
.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
.3 Do leakage test in sections.
.4 Make trial leakage tests as instructed to demonstrate workmanship.
.5 Install no additional ductwork until trial test has been passed.
.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degree elbows.
.7 Complete test before insulation or concealment.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 23 05 00- Common Work Results for HVAC

1.2 REFERENCES

.1 ASTM International (ASTM)
  .1 ASTM C518- Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  .2 ASTM E84- Standard Test Method for the Surface Burning Characteristics of Building Materials.

.2 American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
  .1 ASHRAE Design Fundamentals Handbook.
  .2 ASHRAE 90.1- Energy Standard for Buildings Except for Low-Rise Residential Buildings.

.3 National Fire Protection Agency (NFPA)
  .1 NFPA 90A- Standard for the Installation of Air-Conditioning and Ventilating Systems.
  .2 NFPA 90B- Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
  .1 SMACNA HVAC Air Duct Leakage Test Manual.
  .2 SMACNA Phenolic Duct Construction Standards.
  .3 SMACNA HVAC Duct System Design Manual.

.5 Underwriters Laboratories (UL)
  .1 UL 181- Standards for Factory Made Air Ducts and Air Connectors.
  .2 UL 723- Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

.1 Submit as per requirements of Division 01 - General Requirements.

.2 Product Documentation: Manufacturer’s documentation on each product to be used, including:
  .1 Technical Data Sheets.
  .2 Material Safety Data Sheets.
  .3 Installation and Maintenance Manual.

.3 Shop Drawings & Production Submittal: CAD drawings and production release documentation to including the following.
  .1 Plan & Elevation views: Scaled and annotated with duct sizes, lengths, and elevations dimensions.
  .2 Isometric Views: 3D layout drawing of system with item numbering for part identification.
  .3 Item Shop Drawing: Shop drawings for each duct item, displaying plan, elevation and isometric views. Detailed duct information including dimensions, connector type, seam type, duct specification, and accessories.
  .4 Item summary: line item list indicating part numbers, duct types, specifications, and duct size.

1.4 QUALITY ASSURANCE

.1 Single Source Responsibility: Contractor to source primary materials from a single manufacturer.

.2 Installer Qualifications: Contractor to receive webinar installation training or onsite installation training as provided by manufacturer.

1.5 PRE-INSTALLATION MEETINGS

.1 Convene with the manufacturer's authorized technical representative, general contractor, and related trades minimum of 2 weeks prior to starting execution of this section to discuss timeline, project conditions, and manufacturer's installation procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store products in manufacturer's original packaging until ready for installation.
.2 Follow manufacturers procedures for proper storage and handling upon delivery.
.3 Duct Products shall be shipped with open ends covered to protect interior from dust, debris, & moisture.

1.7 PROJECT CONDITIONS

.1 Ensure environmental conditions (temperature, humidity, ventilation) during installation are within limits recommended by the manufacturer.
.2 Do not install products under environmental conditions outside of manufacturer's recommendations.

1.8 SEQUENCING

.1 Ensure that products of this section are supplied to trades in time to prevent interruption of construction process.
.2 Verify production lead times with product manufacturer prior to scheduling installation of this section.

2 Products

2.1 PRE-INSULATED OUTDOOR HVAC DUCTWORK SYSTEM

.1 Pre-Insulated Outdoor HVAC Ductwork system:
  .1 Duct System for HVAC supply, return, and exhaust air ductwork as shown on layout drawings.
  .2 System shall include pre-insulated panels, coupling systems, sealants, cladding and accessories to meet the following performance criteria.
.2 Materials
  .1 Ductwork
    .1 Pre-Insulated Duct Panels: UL 181 listed rigid thermoset phenolic duct panel
      .1 Minimum internal facing: 2.3 mil (60 micron) embossed aluminum
      .2 Minimum external facing: 7.9 mil (200 micron) embossed aluminum
      .3 Nominal Density: 4.05 lbs/ft^3 (60 kg/m^3)
      .4 Closed Cell Content: Minimum 90%
      .5 Compressive Strength: Minimum 29 psi (200 kPa) at 10% compression
    .2 Cladding: UL 181 listed multi-layered aluminum laminate cladding
      .1 Minimum cladding thickness 19.7 (500 micron) mil
    .3 Tape: UL 181 listed foil mastic sealant tape
  .2 Metal Accessories
    .1 Corrosion Resistant Construction
      .1 Turning vanes, reinforcement, support mounts, and connector material to be fabricated from corrosion resistant galvanized steel.
  .3 Air Leakage
    .1 Duct shall exceed a SMACNA Air Leakage Class 1
      .1 Standard Pressure Design
        .1 Design Pressure @ 1" WG = 1 cfm/100 sqft
        .2 Design Pressure @ 2" WG= 1.6 cfm/100 sqft

.3 Design Pressure @ 3" WG= 2.1 cfm/100 sqft
.4 Design Pressure @ 4" WG= 2.5 cfm/100 sqft

.4 Air Velocity
.1 Maximum 6890 fpm (35 m/s)

.5 Design Pressure Reinforcement Specification
.1 Duct shall be reinforced to meet the 4" WG Pressure Class
.1 Maximum Positive 4" WG (1000 Pa)
.2 Maximum Negative 4" WG (1000 Pa)

.6 Duct Connections
.1 Duct connections must exceed SMACNA Leakage Class 1
.1 Interlocking connection permitted.
.2 TDC/TDF connection permitted.
.3 4-Bolt Flange connection permitted

.7 Duct R-Value, Insulation Panel Layers, Nominal Wall Thickness
.1 R-24: Quad Panel, 5.00" wall thickness: + additional R-8.6 Sloped Roof Insulation

.8 Field Paintable
.1 Duct system shall be capable of applying field paint by others
.2 Color selected by Architect

.9 Warranty
.1 Manufacturer shall provide a 10-year limited warranty for the Pre-Insulated Outdoor HVAC Ductwork system.

.10 Mounting System
.1 Horizontal Ductwork Support Universal Mounting Rails
.1 Factory supplied & attached external support rails on all ducts longer than 24" & depth greater than 24".
.2 Vertical Ductwork Support Universal Mounting Rails
.1 Factory supplied & attached external support rails on all straight ducts with vertical rise greater than 6'.
.3 Support Mounting Rails for all Ducts and Fittings
.1 Factory supplied & attached external support rails on all straight duct regardless of size or reinforcement specification.

.11 Sloped Roof Water Shed
.1 Roof Slope: Minimum roof slope of ½" per 1'
.2 Roof Insulation: Minimum R-8.6 at 1.5" insulation thickness.
.3 Roof Cladding: UL 181 listed multi-layered 19.5 mil aluminum laminate cladding

2.2 FABRICATION

.1 Ductwork to be factory fabricated with pre-insulated and jacketed exterior, adhesives, sealants, connectors, reinforcements, supports and accessories in accordance with Manufacturer's specifications and the SMACNA Phenolic Duct Construction Standards.
.1 90-degree rectangular elbows shall include turning vanes per SMACNA Phenolic Duct Construction Standards.
.2 Duct reinforcement shall meet or exceed SMACNA Phenolic Duct Construction Standards.

3 Execution

3.1 EXAMINATION

.1 Do not begin installation until roof substrates have been properly prepared.
.2 If substrate preparation is the responsibility of another installer, notify the Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

.1 Ensure interior & exterior surfaces of product are clean of dirt, debris and moisture prior to installation.
.2 Ensure work site is clear of obstructions to allow for safe handling of material during installation process.

3.3 INSTALLATION

.1 Install in accordance with manufacturer's instruction manual.
.2 Installing contractor is responsible for properly supporting duct system in accordance with manufacturer's instructions. Support and install materials are to be checked for compatibility with duct system.
.3 Join and seal sections in accordance with manufacturer's specifications.
.4 Refer to manufacturer's instructions for field modifications of duct system.
.5 Ensure products are properly protected until completion of project.
.6 Touch-up, repair or replace damaged products before substantial completion of installation.

3.4 FIELD QUALITY CONTROL

.1 Commissioning: Testing and verification of operational performance at intended pressure and temperature ranges. Commission test pressure is not to exceed design pressure.
.2 Air Leakage Testing: Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual on at least 10% of the total installed duct area, after all duct has been secured to the duct supports. Ensure duct system exceeds SMACNA Air leakage Class 1.

END OF SECTION9

1 General

1.1 GENERAL

.1 Refer to General and Special Conditions for other requirements included and outlined in other Sections of the specifications.

1.2 SCOPE OF WORK

.1 Provide all labour, materials, facilities, equipment and services to thoroughly clean the ductwork and fans for the supply air systems and all the related exhaust air systems installed or modified in this Contract.

.2 The cleaning work shall include, but not be limited to the following:

- .1 All existing supply and return ductwork serving Stores Area from AHU-12.
- .2 New ductwork installed in this Contract.
- .3 All reheat boxes, grills and diffusers.
- .4 Air Handling Unit AHU-12 using wet cleaning method. Including associated supply fans and return fans, plenums, scrolls, blades, vanes, shafts, baffles, dampers, drive assemblies, drains, coils and condensate pans. Verify cleanliness per NADCA Standard.

.3 Provide all labour and services to obtain access to HVAC systems and associated components including removal of ceiling tiles.

.4 Replace or repair any damage to mechanical components, ceiling or walls caused during the duct cleaning.

.5 Scope of work to include the following:

- .1 Carry out field inspection and review to determine the method of cleaning the HVAC systems and its components. Submit to the Consultant, the proposed methods for cleaning and their efforts to the system.
- .2 Reset all balancing dampers to original settings if moved during cleaning. Be sure to mark original position so that during the final inspections, original settings can be field verified.
- .3 Report to the Consultant, any system defects discovered during the cleaning operation which will require remediation to an HVAC system (e.g. equipment, ductwork, dampers, registers, etc.).

1.3 QUALITY ASSURANCE

.1 Ductwork shall be cleaned in compliance with mechanical cleaning of Non-Porous Air Conveyance System Components NADCA 1992-01.

.2 All duct and fan surfaces must be visibly clean and capable of passing the NADCA vacuum test. The weight of debris collected by the NADCA Vacuum Test, shall not exceed 1.0mg/100cm².

2 Products

2.1 NOT APPLICABLE.

.1 Not applicable.

3 Execution

3.1 PRE-CLEANING PREPARATIONS

.1 Prior to start of work, the HVAC system is to be carefully inspected and checked for all conditions affecting the cleaning. Defects are to be reported in writing to the Consultant and work will not proceed until defects have been documented.

.2 Fire protection devices such as smoke detectors, etc. shall be protected prior to cleaning procedures.

.3 The Contractor shall have samples collected by gathering the gross debris from the

.1 surface of the duct at a minimum of three (3) locations per system prior to and after cleaning. This shall be accomplished by utilizing protective clean surgical gloves to handle the surface debris. at 100cm² area shall be scraped and the debris placed in a 4 oz. sterile container with screw cap. The container shall be adequately marked as to sample location, date and time. The total weight will be established per 100cm².

3.2 CLEANING AND REMOVAL METHOD

.1 The following general ductwork cleaning procedures are to be used as a guideline.

.1 Determine which method should be used in each area and submit detailed description of the procedures to the Consultant.

.2 Debris Collection Equipment:

.1 Equipment shall be portable and sized to enter the areas easily. Electrical requirements shall be the responsibility of the cleaning Contractor.

.2 The collection system shall be self-contained units, with the appropriate components to adequately collect dirt and debris loosened from the ductwork. Air duct cleaning is to be performed by a high powered vacuum system with three stages of filtration. The final stage to be a HEPA filter.

.3 The collection system shall be capable of producing a minimum of 0.42" water gauge negative static pressure and 0.25" water gauge velocity pressure in the area of ductwork to be cleaned.

.3 Agitation Equipment:

.1 Air power cleaning of all interior ductwork, fan housings and HVAC units performed be a high pressure compressed air system, which will be directed through small access doors in the ductwork. The size and the number of access doors required for cleaning shall be determined by this Section.

.2 Air powered lances, extended whip sections or oscillating brush systems shall be used as a means of dislodging the debris.

.3 Where ductwork is large enough and able to support the weight of a worker, hand tools and vacuum may be used. If workers enter the inside of the duct they must follow the OSHA confined space requirements.

.4 Open Ductwork: During the cleaning process, provide temporary closure of metal or taped polyethylene on open ductwork to prevent the dust during the cleaning process from dispersing throughout the work area.

.5 Debris removed during the cleaning process shall be collected and tagged as to its origin within the duct system.

.6 Coils shall be vacuumed such that they are visiblyly clean. Coil drain pans shall be subject to cleaning as per NADCA standards.

.7 Volume and Fire Dampers: Duct mounted volume and fire dampers are to be marked to their current settings and cleaned if necessary.

3.3 VERIFICATION

.1 General verification of cleanliness will be determined after the completion of cleaning process.

.2 All duct and air handling unit surfaces must be visibly clean and capable of passing the NADCA vacuum test.

.3 The weight of debris collected by the NADCA vacuum test shall not exceed 1.0mg/100cm².

.4 The Contractor shall include the cost of four (4) vacuum tests per air handling system to be performed at the time and location as directed by the Consultant. If any areas fail, the system of the failed test shall be recleaned and retested at no cost to the Owner.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).
.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements.
.2 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    .1 Flexible connections.
    .2 Duct access doors.
    .3 Turning vanes.
    .4 Instrument test ports.
  .2 Submit WHMIS MSDS material safety data sheets. Indicate VOC's for adhesive and solvents during application and curing.
.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.5 Instructions: submit manufacturer's installation instructions.
.6 Manufacturer's Field Reports: manufacturer's field reports specified.
.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Division 01 - General Requirements.

2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Materials: Flame-retardant or noncombustible fabrics.
.2 Coatings and Adhesives: Comply with UL 181, Class 1.
.3 Metal-Edge Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4 inch (70 mm) wide, 0.028 inch (0.7 mm) thick, galvanized sheet steel or 0.032 inch (0.8 mm) thick aluminum sheets. Provide metal compatible with connected ducts.
.4 Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  .1 Minimum Weight: 26 oz / sq. yd. (880 g/sq. m).

.2 Tensile Strength: 480 lbf/inch (84 N/mm) in the wrap and 360 lbf/inch (63 N/mm) in the filling.
.3 Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

.5 Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
.1 Minimum Weight: 24 oz / sq. yd. (810 g/sq. m).
.2 Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the wrap and 440 lbf/inch (77 N/mm) in the filling.
.3 Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

.6 High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
.1 Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
.2 Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.
.3 Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

.7 High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical resistant coating.
.1 Minimum Weight: 14 oz / sq. yd. (474 g/sq. m).
.2 Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
.3 Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

.8 Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
.1 Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
.2 Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
.3 Minimum Additional Travel: 50 percent of the required deflection at rated load.
.4 Lateral Stiffness: More than 80 percent of rated vertical stiffness.
.5 Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
.6 Elastomeric Element: Molded, oil-resistant rubber or neoprene.
.7 Coil Spring: Factory set and field adjustable for a maximum of 1/4 inch (6 mm) movement at start and stop.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
.3 Gaskets: neoprene.
.4 Hardware:
.1 Hold open devices.
.2 300 x 300 glass viewing panels.
.3 Up to 300 x 300 mm: two sash locks complete with safety chain.
.4 301 to 450 mm: four sash locks complete with safety chain.
.5 451 to 1000 mm: piano hinge and minimum two sash locks.
.6 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.1 Hold open devices.
.2 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated single thickness, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.
.2 Cam lock handles with neoprene expansion plug and handle chain.
.3 28 mm minimum inside diameter. Length to suit insulation thickness.
.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
.2 Sheet metal thickness to co-responding round duct standards.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Flexible Connections:
  .1 Install in following locations:
    .1 Inlets and outlets to supply air units and fans.
    .2 Inlets and outlets of exhaust and return air fans.
    .3 As indicated.
  .2 Length of connection: 100 mm.
  .3 Minimum distance between metal parts when system in operation: 75 mm.
  .4 Install in accordance with recommendations of SMACNA.
  .5 When fan is running:
    .1 Ducting on sides of flexible connection to be in alignment.
    .2 Ensure slack material in flexible connection.
.2 Access Doors and Viewing Panels:
  .1 Size:
    .1 600 x 600 mm for person size entry.
    .2 450 x 450 mm for servicing entry.
    .3 300 x 300 mm for viewing.
    .4 As indicated.
  .2 Locations:
    .1 Fire and smoke dampers.
    .2 Control dampers.
    .3 Devices requiring maintenance.
    .4 Required by code.
    .5 Reheat coils.
    .6 Elsewhere as indicated.
.3 Instrument Test Ports:
  .1 General:
    .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  .2 Locate to permit easy manipulation of instruments.
  .3 Install insulation port extensions as required.
  .4 Locations:

.1 For traverse readings:
  .1 Ducted inlets to roof and wall exhausters.
  .2 Inlets and outlets of other fan systems.
  .3 Main and sub-main ducts.
  .4 And as indicated.
.2 For temperature readings:
  .1 At outside air intakes.
  .2 In mixed air applications in locations as approved by Consultant.
  .3 At inlet and outlet of coils.
  .4 Downstream of junctions of two converging air streams of different temperatures.
  .5 And as indicated.

.4 Turning vanes:
  .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations as specified in Division 01 - General Requirements and in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SUMMARY

.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)
  .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
.2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
  .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  .2 Instructions: submit manufacturer's installation instructions.
    .1 Consultant will make available one (1) copy of systems supplier's installation instructions.

2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
.2 Single thickness construction.
.3 Control rod with locking device and position indicator.
.4 Rod configuration to prevent end from entering duct.
.5 Pivot: piano hinge.
.6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
.3 Locking quadrant with shaft extension to accommodate insulation thickness.
.4 Inside and outside nylon end bearings.
.5 Channel frame of same material as adjacent duct, complete with angle stop.
.6 Gear driven cable operation. Cable case shall be galvanized steel, solid core control wire shall be stainless steel. Coordinate cable length on site with access location.
  .1 Acceptable material: Durodyne GXCODR.

2.4 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
  .1 .1 Frame: minimum 16 Ga galvanized steel hat channel with mitered and welded corners. Provide 0.10 in thick aluminum hot channel frame for manual volume dampers installed in aluminum ductwork.
.3 Blades: Roll formed, 18 Ga galvanized steel, 4 inch maximum blade width. Provide roll-formed, 0.10 inch thick aluminum blade for manual volume dampers installed in aluminum ductwork, maximum 4 inch blade width.
.4 Blade Axles:
  .1 1/2" diameter square or hex plated steel.
  .2 1/2" diameter square or hex type 316 stainless steel axles for manual volume dampers installed in aluminum ductwork.
.5 Control Rod:
  .1 1/2" diameter plated steel or 3/8" square plated steel. Control rod located out of the airstream.
  .2 1/2" diameter or 3/8" square type 316 stainless steel control rod for manual volume dampers installed in aluminum ductwork. Control rod located out of the airstream.
.6 Bearings: Nylon, molded synthetic, or self-lubricating porous bronze.
.7 Finish: Mill.
.8 Performance: Designed for maximum pressure differential of 2" s.p. for 48", maximum temperature of 150 deg F, and maximum system velocity of 2,000 feet per minute.
.9 Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32 inch (2.4 mm) thick zinc-plated steel, and a 3/4 inch (19 mm) hexagon locking nut. Include center hole to suit damper operating rod size. Include elevated platform for insulated duct mounting.
.10 Jackshaft: 1 inch (25 mm) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multi-damper assemblies.
  .1 Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
.11 Acceptable material: Ruskin MD-35/OB, Greenneck, MBD-15, Ventex, TAMCO, EH Price CLD-GV5-3V-MBD.

3 Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install where indicated.
.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
.5 Dampers: vibration free.
.6 Ensure damper operators are observable and accessible.

END OF SECTION

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
  .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.2 SUMMARY

.1 Section Includes:
  .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.3 SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
  .2 Indicate the following:
    .1 Performance data.
.2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
  .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  .2 Instructions: submit manufacturer's installation instructions.
    .1 Consultant will make available one (1) copy of systems supplier's installation instructions.
.3 Closeout Submittals
  .1 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.

2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade or parallel blade type as indicated.
.2 Control Dampers:
  .1 Construction: blades, 152mm wide, 1219mm long, maximum. Modular maximum size, 1219mm wide x 2438mm high. Multiple sections to have stiffening mullions and jack shafts.
  .2 Materials`:
    .1 Frame: 2.3mm minimum thickness galvanized steel or extruded aluminium.
    .2 Blades: structurally formed galvanized steel with two (2) sheets 0.5mm thick or extruded aluminium, otherwise reinforced to ensure specified low leakage when fully closed.
    .3 Bearings: oil impregnated sintered bronze. Provide thrust bearings for vertical blades.
    .4 Linkage and shafts: zinc plated steel.
    .5 Seals: replaceable neoprene or stainless steel spring on sides, top, bottom of frame, along all blade edges and blade ends.
  .3 Performance:
    .1 Capacity: refer to specifications.

.2 Leakage: in closed position, less than 2% of rated air flow at 250 Pa, differential across the damper.
.3 Pressure drop: at full open position less than 20 Pa differential across the damper at 7.62 m/s.
.4 Temperature range: -50°C to +100°C.
.5 Arrangements: damper mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.

.3 Operator: by control contractor. See applicable control section.
.4 Insulated aluminum dampers:
.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
.5 Acceptable material: Tamco, Ventex, EH Price, Green Tech or equal.

2.2 DISC TYPE DAMPERS

.1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
.2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
.3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.
.4 Bearings: roller self lubricated and sealed.
.5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
.6 Performance:
.1 Leakage: in closed position less than 0.1 % of rated air flow at 500 kPa pressure differential across damper.
.2 Pressure drop: at full open position less than 25 kPa differential across damper at 10 m/s.

2.3 BACK DRAFT DAMPERS

.1 Suitable for horizontal or vertical mounting.
.2 Maximum Air Velocity: 1500 fpm (8 m/s).
.3 Maximum System Pressure: 2 inch wg (0.5 kPa).
.4 Frame of barometric relief damper shall match the mating duct system or equipment as follows: 0.064 inch (1.6 mm) thick, galvanized sheet steel or 0.063 inch (1.6 mm) thick extruded aluminums, with welded corners and mounting flange.
.5 Blades:
.1 Multiple, 0.050 inch (1.2 mm) thick aluminum sheet.
.2 Maximum Width: 6 inches (150 mm)l
.3 Action: Parallel.
.4 Balance: Gravity.
.5 Eccentrically pivoted.
.6 Blade Seals: Neoprene.
.7 Blade Axles: Galvanized steel.
.8 Tie Bars and Brackets
.1 Material: Aluminum
.2 Rattle free with 90 degree stop.
.9 Return Spring: Adjustable tension.
.10 Bearings: Synthetic.
.11 Accessories:
.1 Flange on intake.
.2 Adjustment device to permit setting for vary differential static pressures.

2.4 RELIEF DAMPERS

.1 Description: Gravity balanced.

.2 Maximum Air Velocity: 1500 fpm (8 m/s).
.3 Maximum Temperature: 150 deg F.
.4 Maximum System Pressure: 2 inch wg (0.5 kPa).
.5 Frame of the pressure relief/intake damper shall match the mating duct system or equipment as follows: 0.074 inch (19 mm) thick, galvanized sheet steel or 0.080 inch (2.03 mm) thick extruded aluminum or 0.074 inch (1.9 mm) thick stainless steel, with welded corners and mounting flange.
.6 Blades: Multiple single-piece blades, center-pivoted maximum 6 inch (150 mm) width, 0.060 inch (1.52 mm) thick galvanized steel sheets with V formed reinforcement or 0.063 inch (1.6 mm) thick extruded aluminum sheets, airfoil shaped.
.7 Blade Action: Parallel.
.8 Blade Seals: Neoprene, mechanically locked.
.9 Blade Axles:
.1 Material: Plated steel.
.2 Diameter: 0.50 inch (12.7 mm).
.10 Tie Bars and Brackets: Plated steel.
.11 Return Spring: Adjustable tension.
.12 Bearings: Steel ball or synthetic pivot bushings.
.13 Accessories:
.1 Adjustment device to permit setting for varying differential static pressure.
.2 Counterweights (on for every five blades) and spring-assist kits for vertical airflow installations.
.3 Electric actuator.
.4 Chain pulls.
.5 Screen Mounting: Front mounted in sleeve.
.1 Sleeve Thickness: 20 gage (1.0 mm) minimum.
.2 Sleeve Length: 6 inches (152 mm) minimum.
.6 Screen Mounting: Rear mounted.
.7 Screen Material shall match the mating duct system: Galvanized steel, Stainless steel or Aluminum.
.8 Screen Type: Insect.
.9 90 degree stops.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install where indicated.
.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
.3 Seal multiple damper modules with silicon sealant.
.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
.5 Ensure dampers are observable and accessible.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Fire and smoke dampers, and fire stop flaps.

1.2 RELATED SECTIONS

.1 Section 23 31 13 - Metal Ducts Low Pressure.

1.3 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
- .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)
- .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
- .2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .3 ULC-S505, Fusible Links for Fire Protection Service.

1.4 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
- .2 Indicate the following:
  - .1 Fire dampers.
  - .2 Smoke dampers.
  - .3 Fire stop flaps.
  - .4 Operators.
  - .5 Fusible links.
  - .6 Design details of break-away joints.

.2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals:
- .1 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.5 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Division 01 - General Requirements.

.2 Provide following:
- .1 2 fusible links of each type.

2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B or C, blades out of Air Stream, listed and bear the label of UL/ULC, meet requirements of ANSI/NFPA 90A and provincial fire authority. Fire damper assemblies fire tested in accordance with CAN4-S112. Type A dampers will not be accepted.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

- .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
- .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: offset single damper, round or square; multi-blade hinged, interlocking type; roll door type or guillotine type; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA fire, smoke and radiation damper installation guide for HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.2 FIRE STOP FLAPS

.1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C.

2.3 SMOKE DAMPERS

.1 To be ULC or UL listed and labelled.

.2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

.3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.

.4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.

.5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 deg C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

2.4 COMBINATION FIRE AND SMOKE DAMPERS

.1 Damper: similar in all respects to smoke dampers specified above.
.2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system from fusible link.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
.2 Maintain integrity of fire separation.
.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
.5 Co-ordinate with installer of firestopping.
.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
.7 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

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1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).
.3 National Fire Protection Association (NFPA).
  .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  .2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
.4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, (Addendum No.1, November 1997).
  .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition.
.5 Underwriters' Laboratories Inc. (UL).
  .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
.6 Underwriters' Laboratories of Canada (ULC).
  .1 CAN/ULC-S110, Fire Tests for Air Ducts.

1.2 SUBMITTALS

.1 Make submittals in accordance with Division 01 - General Requirements.
.2 Product Data: submit for the following:
  .1 Thermal properties.
  .2 Friction loss.
  .3 Acoustical loss.
  .4 Leakage.
  .5 Fire rating.
.3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Division 01 - General Requirements.

1.3 QUALITY ASSURANCE

.1 Certification of Ratings:
  .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
.2 Health and Safety:
  .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.
.2 Waste Management and Disposal:
  .1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.
  .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  .3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  .4 Place materials defined as hazardous or toxic in designated containers.
  .5 Handle and dispose of hazardous materials in accordance with Provincial regulations.
  .6 Ensure emptied containers are sealed and stored safely.
  .7 Fold up metal banding, flatten and place in designated area for recycling.

1.5 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

.1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

2 Products

2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.
.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - UNINSULATED

.1 Type 1: spiral wound flexible aluminum, as indicated.
.2 Performance:
  .1 Factory tested to 2.5 kPa without leakage.
  .2 Maximum relative pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

.1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl, reinforced mylar/neoprene laminate, or aluminum jacket, as indicated.
.2 Performance:
  .1 Factory tested to 2.5 kPa without leakage.
  .2 Maximum relative pressure drop coefficient: 3.
  .3 Thermal loss/gain: 1.3 W/m2 degrees C mean.

2.4 NON-METALLIC - UNINSULATED

.1 Type 3: non-collapsible, coated mineral base fabric or aluminum foil mylar type, mechanically bonded to, and helically supported by, external steel wire, as indicated.
.2 Performance:
  .1 Factory tested to 2.5 kPa without leakage.
  .2 Maximum relative pressure drop coefficient: 3.

2.5 NON-METALLIC - INSULATED

.1 Type 4: non-collapsible, coated mineral base fabric or aluminum foil/mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl or reinforced mylar/neoprene laminate jacket, as indicated.
.2 Performance:
  .1 Factory tested to 2.5 kPa without leakage.
  .2 Maximum relative pressure drop coefficient: 3.
  .3 Thermal loss/gain: 1.3 W/m2 degrees C mean.

2.6 NON-METALLIC - ACOUSTIC INSULATED

.1 Type 7: non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible mineral fibre acoustic insulation and encased in aluminum foil/mylar laminate vapour barrier, as indicated.
.2 Performance:
  .1 Factory tested to 2.5 kPa without leakage.
  .2 Maximum relative pressure drop coefficient: 3.
  .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

	FREQUENCY (Hz):				
Duct Diam.	**125**	**250**	**500**	**1000**	**2000**
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

3 Execution

3.1 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110, NFPA 90A & 90B and SMACNA.

END OF SECTION

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1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- .2 ASTM C916, Standard Specification for Adhesives for Duct Thermal Insulation.
- .3 ASTM C1071, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .4 ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- .5 ASTM G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Association (NFPA).
- .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.4 North American Insulation Manufacturers Association (NAIMA).
- .1 NAIMA AH116, Fibrous Glass Duct Construction Standards.

.5 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
- .1 SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible.
- .2 SMACNA IAQ Guideline for Occupied Buildings 95.

.6 Transport Canada (TC).
- .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.7 Underwriter's Laboratories of Canada (ULC).
- .1 CAN/ULC-S102, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 SUBMITTALS

.1 Submit product data in accordance with Division 01 - General Requirements

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01 - General Requirements

1.3 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse in accordance with Division 01 - General Requirements.

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

.3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

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

.5 Handle and dispose of hazardous materials in accordance with Provincial regulations.

.6 Ensure emptied containers are sealed and stored safely.

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

2 Products

2.1 DUCT LINER

.1 General:
- .1 Mineral Fibre duct liner: air surface coated mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
- .3 Fungi resistance: to ASTM C1338, ASTM G 21.

.2 Rigid:
- .1 Use on flat surfaces where indicated.
- .2 25 mm thick, to ASTM C1071, Type 2, fibrous glass rigid board duct liner.
- .3 Density: 48 kg/m3 minimum.
- .4 Thermal resistance to be minimum 0.76 (m2. degrees C)/W for 25 mm thickness, 1.15 (m2 degree C)/W for 38 mm, 1.53 (m2, degree C)/W for 50 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
- .5 Maximum velocity on faced air side: 20.3 m/sec.
- .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.

2.2 ADHESIVE

.1 Adhesive: to NFPA 90A and NFPA 90B, ASTM C916.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.

.3 Water-based fire retardant type.

2.3 FASTENERS

.1 Weld pins 3.8 mm diameter, length to suit thickness of insulation. Nylon or metal retaining clips, 32 mm square.

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

.1 Meet requirements of NFPA 90A & 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA HVAC Duct Construction Standards except as specified otherwise.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:
- .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916
  - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres to compress duct liner sufficiently to hold it firmly in place.
.1 Spacing of mechanical fasteners in accordance with SMAC HVAC Duct Construction Standards.

.2 In systems, where air velocities exceeds 10.6 m/sec, install galvanized sheet metal noising to leading edges of duct liner.

3.3 JOINTS

.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
.1 Bed tape in sealer.
.2 Apply two coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Consultant.

.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

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1 General

1.1 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)
- .1 AMCA Publication 99, Standards Handbook.
- .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
- .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

.4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE 51, laboratory methods of testing fans for aerodynamic performance rating.

.5 National Electric Manufacturers Association (NEMA)
- .1 NEMA MGI motors and generators.
- .2 NEMA ICS 7.1 safety standards for construction and guide for selection, installation and operation of adjustable drive systems.

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:
- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
- .2 Capacity: flow rate, total pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.3 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:
- .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

.3 Provide:
- .1 Fan performance curves showing point of operation, BHP and efficiency.
- .2 Sound rating data at point of operation.
- .3 Dimensional data.
- .4 Installation procedures.

.4 Indicate:
- .1 Motors, sheaves, bearings, shaft details.
- .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

.5 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:
.1 Provide operation and maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.4 MAINTENANCE

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Division 01 - General Requirements.
.1 Spare parts to include:
.1 Matched sets of belts.
.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
.1 Bearings and seals.
.2 Addresses of suppliers.
.3 List of specialized tools necessary for adjusting, repairing or replacing.
.4 Belts.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with Division 01 - General Requirements.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

2 Products

2.1 FANS GENERAL

.1 Capacity: Flow rate, static pressure, BHP, Efficiency, Revolutions per minute, power, model, size, sound power data, and as indicated on schedule.
.2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
.3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.
.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANS/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
.5 Motors:
.1 Open drip proof outside of air stream, TEFC when in air stream explosion proof as indicated in accordance with NEMA MG1.
.2 In accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment supplemented as specified herein.
.3 For use with variable speed controllers.
.4 Sizes as indicated.
.5 Two speed with two windings and speeds 1200 or 900 r/min low and 1800 r/min high.
.6 Two speed with split winding, constant horsepower or constant or variable torque and speeds as indicated.
.6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards, fan inlet or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, inlet or outlet dampers and vanes and as indicated.
.7 Factory primed before assembly in colour standard to manufacturer.
.8 Scroll casing drains: as indicated.
.9 Finish on fume hood exhaust fans: heresite coated.

.10 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
.11 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
.12 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS

.1 Fan wheels:
  .1 Welded steel or aluminum construction.
  .2 Maximum operating speed of centrifugal fans not more than 40 % of first critical speed.
  .3 Air foil blades, as indicated.
.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.
.3 Shaft seals on laboratory fume hood exhaust fans:
  .1 Single disc or stuffing box seals.
.4 Housings:
  .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, cast iron, steel, aluminum, for smaller wheels, braced, and with welded supports.
  .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
  .3 Provide bolted airtight access doors with handles.
  .4 Spark resistant construction Type B minimum where indicated.
.5 Variable volume control devices:
  .1 Variable Speed Drives: to NEMA ICS 7.1 or as indicated in Controls and Instrumentation specifications.

2.3 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.
.2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard casing.
.3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 25 mm thick rigid acoustic insulation, pinned and cemented, complete with metal nosings on exposed edges.

2.4 UTILITY SETS

.1 Characteristics and construction: for centrifugal fans.
.2 Preassemble single width centrifugal fan with removable weatherproof protective hood with vents, and automatic spring loaded back draft dampers.
.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.5 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: as for centrifugal fan wheels and direct or belt drive as indicated.
.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
.2 Provide sheaves and belts required for final air balance.
.3 Bearings and extension tubes to be easily accessible.
.4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

3.4 START-UP

.1 General:
  .1 Lubricate bearing and other motor parts with manufacturer's recommended lubricant.
  .2 Rotate impeller by hand and check for shifting during shipment.
  .3 Check all belts, collars, and other parts for tightness.
  .4 Clean fan interior to remove foreign material, construction dirt and dust.

3.5 PERFORMANCE VERIFICATION

.1 General
  .1 Verify operation of motor, drive system and fan wheel.
  .2 Check for vibration and correct if necessary after air balancing is complete.
  .3 Provide replacement pulleys and sheaves as required by air balancing Contractor.

3.6 FIELD QUALITY CONTROL

.1 Commissioning:
  .1 Manufacturer to:
    .1 Certify installation.
    .2 Start up and commission installation.
    .3 Carry out on-site performance verification tests.
    .4 Demonstrate operation and maintenance.
  .2 Provide Consultant at least 24 hours notice prior to inspections, tests and demonstrations. Submit written report of inspections and test results.

END OF SECTION

1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)
- .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.3 International Organization of Standardization (ISO)
- .1 ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.4 Underwriter's Laboratories (UL)
- .1 UL 181, Factory-Made Air Ducts and Air Connectors.

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:
- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.
- .2 Test data: to ANSI/AMCA 210.
  - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
  - .2 Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.
  - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

.2 Shop Drawings:
- .1 Submit shop drawings in accordance with Division 01 - General Requirements.
- .2 Indicate the following:
  - .1 Capacity.
  - .2 Pressure drop.
  - .3 Noise rating.
  - .4 Leakage.
  - .5 Dimensions.

.3 Quality Assurance Submittals:
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Division 01 - General Requirements.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Division 01 - General Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance Division 01 - General Requirements.

1.6 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance withDivision 01 - General Requirements.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
  - .1 Bearings and seals.
  - .2 Addresses of suppliers.
  - .3 List of specialized tools necessary for adjusting, repairing or replacing.

2 Products

2.1 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.2 CONSTANT VOLUME BOXES

.1 Pressure independent reset to air flow between zero and maximum air volume.
.2 Sizes, capacities, differential pressures and sound ratings: as indicated.
.3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
.4 Sound ratings of assembly not to exceed 35 NC at 750 Pa. Use sound attenuation if necessary to achieve rating.
.5 Complete with:
- .1 Operator and controller: as specified under Section 25 30 02 - EMCS: Field Control Devices.
- .2 Sound attenuator: as indicated or as product of manufacturer.
- .3 Multiport outlet adapter: as indicated.
- .4 Reheat coil: as indicated.

.6 Casing: constructed of 0.75 mm thick galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL 181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
.7 Damper: galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
.8 Acceptable Material: E.H. Price, Titus, Nailor.

2.3 HEATING AND COOLING COILS

.1 Conform to ASTM B75 and AHRI 410.

.2 Tubes:
.1 Minimum 16mm tube diameter; seamless copper tubing.
.3 Fins:
.1 0.1397mm aluminum or 0.1143mm copper mechanical bonded or soldered or helically wound around tubing.
.4 Headers:
.1 Copper, welded steel or cast iron. Provide seamless copper tubing or resistance welded steel tube for volatile refrigerant coils.
.5 "U" bends:
.1 Where used: machine die-formed, silver brazed to tube ends.
.6 Coil Casing:
.1 1.6mm galvanized steel with tube supports at 1200mm maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.
.7 Pressure kPa (PSIG):

Pressure	**Water Coil**	**Steam Coil**	**Refrigerant Coil**
Test	2070 (300)	1725 (250)	2070 (300)
Working	1380 (200)	520 (75)	1725 (250)

.8 Protection:
.1 Unless protected by the coil casing, provide cardboard, plywood or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.
.9 Vents and Drains:
.1 Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.
.10 Cooling Coil Condensate Drain Pan: Drain pan shall be designed to be extend entire length of cooling coils including headers and return bends. Depth of drain pan shall beat least 43mm and shall handle all condensate without overflowing. Drain pan shall be single-wall, sloping type and fabricated from stainless steel (304). Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be integrated into duct assembly. Drain pan shall be pitched in all directions to drain line.
.1 Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
.2 Installation, including frame, shall be designed and sealed to prevent blow-by.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.
.2 Support independently of ductwork.
.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
.4 Locate controls, dampers and access panels for easy access.

3.3 CLEANING

.1 Proceed in accordance with Division 01 - General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SYSTEM DESCRIPTION

.1 Performance Requirements:
- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.2 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

1.3 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Division 01 - General Requirements.
- .2 Include:
  - .1 Keys for volume control adjustment.
  - .2 Keys for air flow pattern adjustment.

2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:
- .1 Full perimeter gaskets.
- .2 Plaster frames where set into plaster or gypsum board.
- .3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: standard.

.5 Acceptable Material: E.H. Price, Titus, Nailor, Tuttle & Bailey.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

.1 General: See Schedule on the Drawings.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 General: See Schedule on the Drawings..

2.5 DIFFUSERS

.1 General: See Schedule on the Drawings.

2.6 LINEAR GRILLES

.1 General: See Schedule on the Drawings.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.
.2 Install with flat head screws in countersunk holes where fastenings are visible.
.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

END OF SECTION

1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
  .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
.2 American Society for Testing and Materials International (ASTM)
  .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).
.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.5 Society of Automotive Engineers (SAE)

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:
  .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
    .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements.
  .2 Indicate following:
    .1 Pressure drop.
    .2 Face area.
    .3 Free area.
    .4 Dimensions.
.2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
  .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  .2 Instructions: submit manufacturer's installation instructions.
    .1 Consultant will make available one (1) copy of systems supplier's installation instructions.
.3 Test Reports:
  .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
  .1 Deliver, store and handle in accordance with Division 01 - General Requirements.

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

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

2 Products

2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured aluminum.

.1 Complete with integral birdscreen of 2.7 mm diameter copper wire.

.2 Vertical backdraft dampers on four faces.

.3 Maximum throat velocity: 3.3m/s intake.

.4 Maximum loss through unit: 15 Pa exhaust static pressure.

.5 Maximum velocity through damper area: 1.5 m/s.

.6 Shape: as indicated.

.2 Birdscreens:

.1 Complete with integral birdscreen of 2.7 mm diameter copper wire. Use 12 mm mesh on exhaust.

2.2 GOOSENECK HOODS

.1 Thickness: to SMACNA.

.1 Kitchen: to ANSI/NFPA 96.

.2 Elsewhere: to ASHRAE.

.2 Fabrication: to SMACNA.

.1 Kitchen: to ANSI/NFPA 96.

.2 Elsewhere: to SMACNA.

.3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 2.7mm diameter copper wire. Use 12 mm mesh on exhaust.

.6 Complete with backdraft dampers.

2.3 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 12 mm exhaust mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish: factory applied enamel. Colour: to Consultant's approval.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.
.2 Reinforce and brace as indicated.
.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management.
.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 09 91 00 - Painting.
.2 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
.4 Section 21 07 18 - Thermal Insulation for Equipment.
.5 Section 23 33 00 - Air Duct Accessories.
.6 Section 23 33 15 - Dampers - Operating.
.7 Section 23 34 00 - HVAC Fans.
.8 Section 23 41 00 - Particulate Air Filtration.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
  .1 ANSI/NFPA-90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
.2 Canadian General Standards Board (CGSB)
  .1 CGSB 1-GP-181M, Ready-Mixed Organic Zinc-Rich Coating.
.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
.4 Canadian Standards Association (CSA)
  .1 CSA B52, Mechanical Refrigeration Code.
  .2 CSA B51, Boiler Pressure Vessel and Pressure Piping Code.
.5 American Bearing Manufacturer's Association (ABMA)
  .1 ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
  .2 ANSI/ABMA 11 Load Ratings and Fatigue for Life for Roller Bearings.
.6 Air Movement and Control Association (AMCA)
  .1 AMCA 204, Standard Balance Quality and Vibration Levels for Fans.
  .2 AMCA 210, Laboratory Method of Testing Fans for Aerodynamics Performance Rating (ASHRAE).
  .3 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
.7 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
  .1 ASHRAE 68, Laboratory Method of Testing to Determine the Sound Power in a Duct.
  .2 ANSI/ASHRAE 90.1, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
  .3 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
.8 Air-Conditioning, Heating and Refrigeration (AHRI)
  .1 ARI 430 Central Station Air Handling Units
  .2 ARI 260 Sound Rating of Ducted Air Moving and Conditioning Equipment
  .3 ARI 400 Forced Circulation Air-Cooling and Air Heating Coils.
.9 National Electrical Manufacturer's Association (NEMA)
  .1 NEMA MG 1 Motors and Generators
  .2 NEMA ICS 7-1 Safety Standards for Construction and Guide Selection, Installation and Operation of Adjustable Speed Drive Systems.
.10 Provincial Boiler Pressure Vessel and Compressed Gas Regulations.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
.2 Indicate following:
  .1 Construction specifications, dimensions, weights, fans, motors, vibration isolation, coils, capacities, curves, filter housing, filters, mixing boxes, dampers, controls, actuators, accessories, installation procedures and controls wiring diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 00 - Cleaning and Waste Management.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Consultant.
.5 Divert unused paint material from landfill to official hazardous material collections site approved by Consultant.
.6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

2 Products

2.1 GENERAL

.1 Field assembled components to form units supplying air at design conditions as indicated.
.2 Contractor to provide for modfications to existing AHU-12 as indicated.

2.2 MANUFACTURED ITEMS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.
.2 Acceptable material: York, McQuay, Carrier, Racan, Engineered Air.

2.3 COILS

.1 General:
  .1 Cleanable tube type: steel or cast iron headers and straight tubes.
  .2 Plate fin type: tubes mechanically bonded to fins. Spiral wound fin type: mechanically bonded to tubes.
  .3 Non-ferrous tubes and headers: brazed assembly.
  .4 Maximum tube length: 3.6 m unless specified otherwise.
  .5 Factory tested with air under water.
  .6 Coils shall be of split type as required for replacement of exisitng coils.
.2 Capacities: as indicated.
.3 Ratings: ARI Certified. Submit with shop drawings actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
  .1 Unless otherwise indicated, dehumidifying coils rated for 2.5 m/s face velocity.
  .2 Unless otherwise indicated, preheat coils rated for 3.5 m/s.
  .3 Pressure drop through heating coils: 30 kPa maximum.
  .4 Pressure drop through cooling coils: 60 kPa maximum.

.5 Water velocity: 1.2 m/s maximum. Under 0.6 m/s, turbulators may be used if manufacturer's standard practice.

.4 Coil casings:
- .1 Mounting: designed for bolting to other sections.
- .2 Steel: die formed 1.6 mm thick galvanized steel sheet, except Type 304 stainless steel for cooling coils.
- .3 Copper at spray washers: 1.6 mm thick cornice temper copper.
- .4 Tube supports: allow for expansion and contraction.
- .5 Supports: steel channel or double angle frames or other approved support. Provide brass supports for copper coils.
- .6 Blank-off plates: of similar material as casing to prevent air bypass. Seal openings where pipes pass through casing using methods recommended by SMACNA.

.5 Hot and chilled water coils: cleanable fins.
- .1 Tubes: copper, brass or steel.
- .2 Fins: aluminum plate or spiral wound.
- .3 Headers: cast iron, steel or cast brass.
- .4 Pressure tests: 1.7MPa.

2.4 DRAIN PANS

.1 Construction: stainless steel or plastic or FRP. Rounded corners.
.2 Insulation: external foam type, minimum 13 mm thick.
.3 Drain connection: in bottom at low point.
.4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.
.5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include all return bends and headers.

3 Execution

3.1 INSTALLATION

.1 Provide appropriate protection apparatus.
.2 Fabricate to provide smooth air flow through components.
- .1 Limit air leakage to 1 % of rated air flow at 2.5 kPa suction pressure.

.3 Apply sealer into all seams prior to assembly.
- .1 Secure toe angles on 300 mm centres for full length of casing.

.4 Paint inside casing surfaces with zinc coating, mastic, corrosion resistant paint. Prime coat outside surfaces.

3.2 DRIP PAN

.1 Install deep deal P trap and trap seal primer on drain lines.
- .1 Depth of water seal to be 1.5 times static pressure at this point.

3.3 START-UP

.1 General:
- .1 The air handling unit shall not be operated for any purpose, temporary or permanent, until duct work is clean, filters are in place, bearings are lubricated and fan has been test run under observation.
- .2 An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training, etc.

3.4 COMMISSIONING

.1 Manufacturer or Manufacturer's representative to:
- .1 Certify installation.
- .2 Provide one (1) day on site per unit for startup and one (1) day for commissioning in two separate visits.
- .3 Carry out on-site performance verification tests.
- .4 Demonstrate operation and maintenance.
- .5 Provide Consultant at least 24 hours notice prior to inspections, tests and demonstrations. Submit written report of inspections and test results.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Provide for relocation of all split system air source heat pump. Provide additional piping and accessories as required to complete the relocation.

1.2 RELATED SECTIONS

.1 Section 23 23 00 - Copper Tubing and Fittings Refrigerant.

1.3 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)
- .1 ARI 210/240, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 ARI 325, Standard for Ground Water - Source Heat Pumps.

.2 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
- .1 ANSI/ARI 320, Standard for Water-Source Heat Pumps.

.3 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
- .1 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.4 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- .1 ASHRAE Standard 15, Safety Standard for Refrigeration Systems.

.5 Canadian Standards Association (CSA International)
- .1 CAN/CSA-C273.3, Performance Standard for Split-System Central Air-Conditioners and Heat Pumps.
- .2 CAN/CSA-C446, Performance of Ground and Water Source Heat Pumps.
- .3 CAN/CSA-C655, Performance Standard for Internal Water-Loop Heat Pumps.
- .4 CAN/CSA-C656, Performance Standard for Single Package Central Air Conditioners and Heat Pumps.

.6 Environment Canada, (EC)/Environmental Protection Services (EPS)
- .1 EPS 1/RA/2, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
- .2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.

.7 ETL Listing Laboratories (ETL).

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Division 01 - General Requirements.

.2 Indicate:
- .1 Capacities.
- .2 ARI Ratings.
- .3 Sound Power levels.
- .4 Installation instructions.
- .5 Start-up Instructions.
- .6 O&M, Instructions.

1.5 WARRANTY

.1 For heat pumps, the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 5 years.

.2 Contractor hereby warrants heat pumps in accordance with GC 24, but for 5 years.

2 Products

2.1 GENERAL

.1 Provide for removal, relocation and reinstatement of existing split system air source or water source heat pumps, as indicated on the plans. Equipment shall be completely assembled, piped and internally wired, capacity and characteristics are listed in the schedule and as shown on the plans.

.2 Heat pumps: EPS 1/RA/2, CSA approved and carry ARI or CSA certification seal.

2.2 REFRIGERANTS

.1 Type of Refrigerant: R410A, R407C or Equal.

3 Execution

3.1 INSTALLATION

.1 Install where indicated and in accordance with manufacturer's instructions.

.2 Install outdoor units at ground level on RC housekeeping pad.

.3 Install outdoor units on roof with vibration isolation providing 95% isolation efficiency. For flashing, roofing, weatherproofing.

.4 Secure with hold-down bolts.

.5 Make duct connections through flexible connections.

.6 Level unit with fans running. Align ductwork. Flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

.7 Make piping connections.

.8 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.2 DRAIN PANS

.1 Install so that no water can accumulate and arrange for easy access for cleaning.

3.3 START-UP AND COMMISSIONING

.1 Manufacturer to certify installation.

.2 Manufacturer to be present during start-up and certify performance.

.3 Manufacturer to provide verbal, and written instructions to operating personnel.

.4 Submit written report to Consultant.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section includes radiant-heating piping, consisting of pipes, fittings, and piping specialties.
.2 Distribution manifolds and compatible fittings.
.3 Fasteners approved by manufacturer.
.4 Furnishing and installation of radiant floor heating system tubing, distribution manifolds with venting / air purge valve, manifold to tubing fittings, embeddable compression sleeve tubing repair couplings, circuit isolation and balancing valves, installation specialties, supervision and field engineering required for complete and proper function of the system.

1.2 GENERAL REQUIREMENTS

.1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 83 16 - Radiant Heating Hydronic Piping.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International):
  .1 ASTM F876, Standard Specification for Cross-linked Polyethylene (PEX) Tubing.
  .2 ASTM F877, Cross-linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution System.
.2 Canadian Standards Association (CSA International):
  .1 CAN / CSA-B137.5, Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications.
.3 DIN (Deutsches Institut für Normung) Standards - published by German Institute for Standardization.
  .1 DIN 4726, Warm Water Surface Heating Systems And Radiator Connecting Systems - Plastics Piping Systems And Multilayer Piping Systems

1.4 REGULATORY REQUIREMENTS

.1 Tubing shall conform to CAN/CSA B-137.5.
.2 Installer's qualification: Sub-contractor responsible for installation of the radiant floor heating system, shall be qualified in writing as either being certified or certifiable prior to the commencement of the installation.

1.5 SUBMITTALS

.1 Note:
  .1 The Drawings indicate a general layout ONLY for the radiant piping.
.2 Product Data:
  .1 Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics
.3 Shop Drawings:
  .1 Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.
  .2 Shop drawings and calculation reports with the following information.
    .1 Submit circuit layout that shows manifold location, pipe spacing, pipe size, circuit length, flow rates, head loss, supply water temperatures for heating, and supply water temperatures for cooling if applicable.
    .2 Provide calculation reports that show output of the heating/cooling system to include any excess or shortages of heating or cooling, heating/cooling entering the space, flow rates, head loss, back losses of heating/cooling, floor covering resistance, and floor surface temperatures

.3 Submit floor cross section details with fastener(s) being used, fastener spacing, insulation requirements, thermal mass thickness (if required), and intended floor covering.
.4 Submit details of manifold, manifold cabinets, valves, and fittings either in a flush mounted installation or a recessed location.
.5 Submit details of slab penetrations.

.4 Coordination Drawings:
.1 Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
.1 Suspended ceiling components.
.2 Structural members to which radiant-heating piping will be attached.
.3 Expansion joints and slab penetrations.
.4 Items penetrating finished ceiling.

.5 Closeout Submittals:
.1 Operation and Maintenance Data:
.1 For radiant-heating piping valves and equipment to include in operation and maintenance manuals.
.2 Technical Data Sheets.
.3 Product Instructions.
.4 Design Calculation Reports.

1.6 WARRANTY

.1 Manufacturer warranty shall include the following:
.1 In the event that manufacturer determines that the failure or leak and any resulting damages were the result of a manufacturing defect in the products covered by the warranty and occurred during the first ten years of the time period covered by the warranty, the manufacturer will reimburse the property owner for reasonable repair or replacement charges resulting from the failure or leak and, additionally will reimburse damages to personal property resulting from the failure or leak.
.2 Radiant heat pipe manufacturer shall warranty the tubing under normal conditions of use and properly maintained, will be free from failure caused by manufacturing defect for a period of thirty (30) years from date of installation, when properly installed by contractors trained by manufacturer.
.3 PEX Press fittings, when installed with ViegaPEX Barrier and FostaPEX tubing, will be free from failure caused by manufacturing defect for a period of thirty (30) years from date of installation. This also includes protected PEX Press fitting in a slab.
.4 Manifolds and panels used in the system will be free from manufacturing defect for a period of five (5) years.
.5 Controls, mixing stations, or electrical components sold by manufacturer shall be free from manufacturing defect for a period of two (2) years from date of installation.

1.7 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Division 01 - General Requirements.

2 Products

2.1 PEX PIPE AND FITTINGS

.1 Pipe Material:
- .1 PEX tubing and fittings shall maintain a quality control program in accordance with ISO 9001 or NSF International in the manufacturing plant to assure that the tubing and fittings are continually being produced to the required standard.
- .2 Tubing shall be silane cross-linked high density polyethylene as per ASTM F876/F877 and CSA B137.5.
- .3 Tubing includes four layers.
  - .1 First layer: Cross-linked, high density polyethylene.
  - .2 Second layer: Adhesive.
  - .3 Third layer: Ethylene vinyl alcohol layer (EVOH oxygen barrier).
  - .4 Fourth layer: Polyethylene to protect the EVOH layer from damage
- .4 Certified to NSF 14 and 61.
- .5 Tubing will have 6 month UV protection.
- .6 Certified to UL 263 ULC S101 for floor and wall assemblies.
- .7 Certified to ASTM E84 and ULC S102.2 Flame Spread (FS)/Smoke Developed (SD) (25/50).

.2 Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104°F (40°C) according to DIN 4726.

.3 Bronze Fittings: PEX Press Fittings manufactured from UNS [C83600] [C87700] [C87710] copper alloy, meeting the requirements of ASTM F 877 tested as a system with ViegaPEX Barrier tubing.
- .1 PEX Press Sleeve: Manufactured out of a 304 grade or better stainless steel, and have three view holes with an attached sleeve to ensure proper PEX tubing insertion.
- .2 Attached sleeve fitting will incorporate a tool locator ring that shall be in place while making a proper press connection.
- .3 PEX Press connection shall be made with a Viega supplied ratcheting PEX Press hand tool or PEX Press power tool.

.4 Pressure/Temperature Rating: ViegaPEX Barrier High-Density Cross-linked polyethylene tubing shall meet the standard grade hydrostatic pressure ratings from the Plastic Pipe Institute in accordance with TR-4/03. The following three ratings are required:
- .1 200°F (93°C) at 80 psi (551 kPa).
- .2 180°F (82°C) at 100 psi (690 kPa).
- .3 73.4°F (23°C) at 160 psi (1102 kPa).

2.2 DISTRIBUTION MANIFOLDS

.1 Stainless Manifold with Balancing Valves and Flow Meters: Minimum NPS 1 1/4 (DN 32).
- .1 Manifolds shall be made of 304 Stainless Steel with nickel-plate valve necks on select models.
- .2 Flow meters, balancing valves, and shut off valves are integrated on manifold.
- .3 Air bleeders and two purge valves are to be integrated on manifold.
- .4 Manifolds have 1 inch (25 mm) NPT removable end caps and 1 1/4 inch (32 mm) Union connections.
- .5 Galvanized steel bracket supplied by Viega.
- .6 Select manifold cabinet based on manifolds, accessories and fittings added.
- .7 Accept optional powerheads for individual zone control.
- .8 Manifold is suitable to receive all SVC connections.
- .9 Flow Meters for Stainless Manifolds:
  - .1 Visual Flow Indicator: Visible indication in a clear plastic cap at top of valve.
  - .2 Body Brass: Nickel plated.
  - .3 Internal Parts: Plastic, EPDM.

.4 Inlet Connection: NPS 1/2 (DN 15), 1/2 inch (12.7 mm) with o-ring.
.5 Measure Range: 0 - 2 gpm.
.6 Handle Style: Rotating ring with lockable cap, no memory stop to retain set position if used for shut off.
.7 CWP Rating: 100 psi (690 kPa).

.10 Thermometers:
.1 Mount on connection.
.2 Case: Stainless steel, 2 inch (50 mm) diameter.
.3 Element: Bimetal coil element.
.4 Movement: Mechanical, connecting element and pointer.
.5 Dial: White aluminum, black lettering.
.6 Pointer: Aluminum, black.
.7 Window: Instrument glass, NS 33 polycarbonate.
.8 Connector: Rigid, back type.
.9 Accuracy: Plus or minus 2 percent of range.

.11 Maximum Operating Pressure: 100 psi (690 kPa).
.12 Maximum Operating Temperature: 180°F (82°C).

.2 Balancing Valves for Stainless Manifolds:
.1 Body: Brass, nickel plated.
.2 Valve Spindle: Brass, EPDM.
.3 Inlet Connection: NPS 1/2 (DN 15), 1/2 inch (12.7 mm) with o-ring.
.4 Operator: Allen Wrench - 5 mm.
.5 CWP Rating: 145 psi (1000 kPa).
.6 Maximum Operating Pressure:. 100 psi (690 kPa)
.7 Maximum Operating Temperature:. 180°F (82°C)

.3 Manual Air Vents:
.1 Body: Brass, nickel-plated.
.2 Operator: Key furnished with valve, or screwdriver bit.
.3 Inlet Connection: NPS 1/2 (DN 15).
.4 Maximum Operating Pressure: 100 psi (690 kPa).
.5 Maximum Operating Temperature:. 180°F (82°C)

.4 Powerheads for Stainless Manifolds (2-wire):
.1 Voltage
.2 Maximum
.3 Operating Power: 1 watt.
.4 Closing/Opening Time:
.5 Stroke:
.6 Actuating Force:
.7 Weight:
.8 Fluid Temperature: 32°F to 212°F (0°C to 100°C).
.9 Visual Function Indicator.
.10 360° Installation Position.
.11 Snap-on Installation.

2.3 PIPING SPECIALTIES

.1 Cable Ties:
.1 Self-extinguishing one-piece, self-locking, Type 6/6 nylon cable ties.
.2 Minimum Width: 0.17 inch (4.3 mm).
.3 Tensile Width: 0.17 inch (4.3 mm).

3 Execution

3.1 EXAMINATION

.1 Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  .1 Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.
  .2 Ensure that surfaces and substrates are level and plumb.
.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

.1 Install the following types of radiant-heating piping for the applications described:
  .1 Piping in Interior Reinforced-Concrete Floors: ViegaPEX Barrier.

3.3 INSTALLATION

.1 Refer to manufacturer's most current installation instructions.
.2 Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.
.3 Install ViegaPEX Barrier at least 4 inches (102 mm) from edge of slabs, walls or other permanent objects.
.4 Install ViegaPEX Barrier continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels. If coupling is required, use Viega PEX Press fitting and wrap in Viega's Coupling Repair Tape.
.5 Avoid void crossing tubing in slab unless minimum concrete thickness is met.
.6 Square off ViegaPEX Barrier or FostaPEX with approved PEX Cutters.
.7 Connect ViegaPEX Barrier or FostaPEX to manifold using approved Viega Manifold Adapters.
.8 Use bend supports for pipe entering and exiting the slab.
.9 Do not bend pipe in radii smaller than manufacturer's minimum bend radius.
.10 Manifolds should be installed with brackets supplied by Viega LLC.
.11 Install manifolds in accessible locations, or install access panels to provide maintenance access.
.12 Comply with requirements in Section 23 21 13 - Hydronic Systems: PEX and Section 23 21 16 - Hydronic Systems: Steel for pipes and connections to hydronic systems and for glycol-solution fill requirements.
.13 Fire and Smoke Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
.14 Piping
  .1 Secure piping by attaching pipes to reinforcement using approved fasteners from manufacturer.
  .2 Space fasteners a maximum of 24 inches (610 mm) and at center of turns and bends.
  .3 Maintain 2 inch (51 mm) minimum cover.
  .4 Install vapor barrier and insulation as per the radiant design. Ensure compression rating is suitable for structural engineer.
  .5 If pipe is being secured to insulation space fasteners a maximum of 24 inches (610 mm) and at center of turns and bends.
  .6 Install a sleeve of 3/8 inch (9.5 mm) thick, foam-type insulation PVC or PE pipe around tubing and extending for a minimum of 12 inches (300 mm) on each side of slab expansion joints to protect the tubing passing through expansion joints. Anchor sleeve to slab form at expansion joints to provide maximum clearance for saw cut.

.7 If tube passes metal expansion joints pass tubing under the joint.
.8 Maintain pressure test of a minimum 100 psig (690 kPa) or 1.5 times system working pressure.
.9 After initial pressurization, ensure pressure has not dropped after 20 minutes. Fluctuations may occur due to temperature fluctuations and tubing expansion. If a drop has occurred add pressure to the system. Carry out testing for a minimum of 1 hour.
.10 Maintain pressure in piping during concrete and floor covering installation and continue for 24 hours after placement.

.15 Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Consulant.

.16 After system balancing has been completed, mark balancing valves to permanently indicate final position per design.

.17 Perform the following adjustments before operating the system:
.1 Open valves to fully open position.
.2 Check operation of automatic valves.
.3 Set temperature controls so all zones call for full flow.
.4 Purge air from piping.

.18 After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:
.1 Start warm up after concrete has reached its final set (curing complete).
.2 Set supply water temperature to 77°F (25°C) for the first three (3) days.
.3 Increase supply water temperature to the set point in gradual increments for the next four (4) days. Maximum of a 50°F (10°C) increase in a period of 24 hours.
.4 For freeze protection, operate at a minimum of 60°F (16°C) supply-water temperature or provide adequate antifreeze protection.

3.4 FIELD QUALITY CONTROL

.1 Prepare radiant-heating piping for testing as follows:
.1 Open all isolation valves and close bypass valves.
.2 Open and verify operation of zone control valves.
.3 Flush with clean water and clean strainers.

.2 Perform the following tests and inspections [with the assistance of a factory-authorized service representative]:
.1 Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than [100 psig (690 kPa)]. Repair leaks and retest until no leaks exist.
.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Radiant-heating piping will be considered defective if it does not pass tests and inspections.

.4 Prepare test and inspection reports.

.5 Protect hydronic piping system from damage during construction.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.
  .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
    .1 Start-up testing and verification of systems.
    .2 Check out demonstration or proper operation of components.
    .3 On-site operational tests.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.
.2 Section 01 78 00 - Closeout Submittals.
.3 Section 01 79 00 - Demonstration and Training.
.4 Section 01 91 13 - General Commissioning Requirements.
.5 Section 25 05 01 - EMCS: General Requirements.

1.3 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  .1 Outage of main power supply in excess of back-up power sources, provided that:
    .1 Automatic initiation of back-up was accomplished.
    .2 Automatic shut-down and re-start of components was as specified.
  .2 Failure of communications link, provided that:
    .1 Controller automatically and correctly operated in stand-alone mode.
    .2 Failure was not due to failure of any specified EMCS equipment.
  .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
    .1 System recorded said fault.
    .2 Equipment defaulted to fail-safe mode.
    .3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.4 DESIGN REQUIREMENTS

.1 Confirm with Consultant that Design Criteria and Design Intents are still applicable.
.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Final Report: submit report to Consultant.
  .1 Include measurements, final settings and certified test results.
  .2 Bear signature of commissioning technician and supervisor
  .3 Report format to be approved by Consultant before commissioning is started.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Consultant in accordance with Section 01 78 00 - Closeout Submittals.
.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.6 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Consultant before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.7 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 00 - Commissioning.
.2 Carry out commissioning under direction of Consultant and in presence of Owner's Representative.
.3 Inform, and obtain approval from, Consultant in writing at least 14 days prior to commissioning or each test. Indicate:
.1 Location and part of system to be tested or commissioned.
.2 Testing/commissioning procedures, anticipated results.
.3 Names of testing/commissioning personnel.
.4 Correct deficiencies, re-test in presence of Consultant until satisfactory performance is obtained.
.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
.6 Load system with project software.
.7 Perform tests as required.

1.8 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Owner's Representative.

1.9 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
.4 Locations to be approved, readily accessible and readable.
.5 Application: to conform to normal industry standards.

3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.
.2 Commission each system using procedures prescribed by the Owner's Representative.

.3 Commission integrated systems using procedures prescribed by Owner's Representative.
.4 Debug system software.
.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.
- .1 General: consists of field tests of equipment just prior to installation.
- .2 Testing may be on site or at Contractor's premises as approved by Consultant.
- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
- .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
- .5 Additional instruments to include:
  - .1 DP transmitters.
  - .2 VAV supply duct SP transmitters.
  - .3 DP switches used for dirty filter indication and fan status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.
- .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
- .8 Consultant to mark instruments tracking within 0.5 % in both directions as "approved for installation".
- .9 Transmitters above 0.5 % error will be rejected.
- .10 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.
- .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
- .2 Include following activities:
  - .1 Test and calibrate field hardware including stand-alone capability of each controller.
  - .2 Verify each A-to-D convertor.
  - .3 Test and calibrate each AI using calibrated digital instruments.
  - .4 Test each DI to ensure proper settings and switching contacts.
  - .5 Test each DO to ensure proper operation and lag time.
  - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
  - .7 Test operating software.
  - .8 Test application software and provide samples of logs and commands.
  - .9 Verify each CDL including energy optimization programs.
  - .10 Debug software.
  - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
  - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Consultant. This document will be used in final startup testing.

.3 Final Start-up Testing: provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Consultant. This document will be used in final startup testing.
- .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
- .2 Detailed daily schedule showing items to be tested and personnel available.
- .3 Consultant's acceptance signature to be on executive and applications programs.
- .4 Commissioning to commence during final startup testing.
- .5 O&M personnel to assist in commissioning procedures as part of training.
- .6 Commissioning to be supervised by qualified supervisory personnel and Consultant.
- .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
- .8 Operate systems as long as necessary to commission entire project.
- .9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
- .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
  - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
- .2 Test to last at least 30 consecutive 24 hour days.
- .3 Tests to include:
  - .1 Demonstration of correct operation of monitored and controlled points.
  - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
- .4 System will be accepted when:
  - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
  - .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.

.5 Owner's Representative to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Consultant, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Owner's Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.
  .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.

1.3 DEFINITIONS

.1 CDL - Control Description Logic.
.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Division 01 - General Requirements, supplemented and modified by requirements of this Section.
.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Consultant prior to anticipated date of beginning of training.
  .1 List name of trainer, and type of visual and audio aids to be used.
  .2 Show coordinated interface with other EMCS mechanical and electrical training programs.
.3 Submit reports within one week after completion of Phase 1 training program that training has been satisfactorily completed.

1.5 QUALITY ASSURANCE

.1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
.2 Consultant reserves right to approve instructors.

1.6 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
.2 Training to be project-specific.

1.7 TIME FOR INSTRUCTION

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.8 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.
.2 Supply manual for each trainee, describing in detail data included in each training program.
  .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.9 TRAINING PROGRAM

.1 To be in 2 phases over 6 month period.
.2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Consultant.

.1 Train O&M personnel in functional operations and procedures to be employed for system operation.
.2 Supplement with on-the-job training during 30 day test period.
.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
.4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
.5 Introduction to direct digital controls and BACnet protocol.
.6 Identification of controls components.
.7 Review of DDC network diagram for the building.
.8 Review of shop drawings for building.
.9 Detailed discussions of sequence of operations.
.10 Walk-through of mechanical systems.

.3 Phase 2: 5 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
.1 Provide multiple instructors on pre-arranged schedule. Include at least following:
.1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
.2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
.3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:
.1 Software and architecture: 10% Logiciel et architecture : 10 %
.2 Application programs: 15% Programmes d'application : 15 %
.3 Controller programming: 50% Programmation du contrôleur : 50 %
.4 Trouble shooting and debugging:10% Dépannage et mise au point : 10 %
.5 Colour graphic generation: 15% Génération de graphiques en couleur : 15 %

1.10 ADDITIONAL TRAINING

.1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.11 MONITORING OF TRAINING

.1 Consultant to monitor training program and may modify schedule and content.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

1.2 RELATED SECTIONS

.1 Section 09 91 00 - Painting.
.2 Section 25 05 02 - EMCS: Submittals and Review Process.
.3 Section 25 05 54 - EMCS: Identification.
.4 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
- .1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
- .1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).
- .1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).
- .1 CEA-709.1, Control Network Protocol Specification.

.6 Electrical and Electronic Manufacturers Association (EEMAC).
- .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

.8 Transport Canada (TC).
- .1 Transportation of Dangerous Goods Act (TDGA).

1.4 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:
- .1 AEL - Average Effectiveness Level.
- .2 AI - Analog Input.
- .3 AIT - Agreement on International Trade.
- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.

.15 DP - Differential Pressure.
.16 ECU - Equipment Control Unit.
.17 EMCS - Energy Monitoring and Control System.
.18 HVAC - Heating, Ventilation, Air Conditioning.
.19 IDE - Interface Device Equipment.
.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.
.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NAFTA - North American Free Trade Agreement.
.26 NC - Normally Closed.
.27 NO - Normally Open.
.28 OS - Operating System.
.29 O&M - Operation and Maintenance.
.30 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.
.36 SP - Static Pressure.
.37 ROM - Read Only Memory.
.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.
.42 WAN - Wide Area Network.

1.5 DEFINITIONS

.1 Point: may be logical or physical.
  .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
  .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: composed of two parts, point identifier and point expansion.
  .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
    .1 Area descriptor: building or part of building where point is located.
    .2 System descriptor: system that point is located on.
    .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
  .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.

.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 Point Object Type: points fall into following object types:
- .1 AI (analog input).
- .2 AO (analog output).
- .3 DI (digital input).
- .4 DO (digital output).
- .5 Pulse inputs.

.4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
- .1 Printouts: to ANSI/IEEE 260.1.
- .2 Refer also to Section 25 05 54- EMCS: Identification.

1.6 SYSTEM DESCRIPTION

.1 Refer to control schematics, sequence of operations and related Divisions of Specifications for system architecture.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
- .1 Building Controllers.
- .2 Control devices as listed in I/O point summary tables.
- .3 OWS(s).
- .4 Data communications equipment necessary to effect EMCS data transmission system.
- .5 Field control devices.
- .6 Software/Hardware complete with full documentation.
- .7 Complete operating and maintenance manuals.
- .8 Training of personnel.
- .9 Acceptance tests, technical support during commissioning, full documentation.
- .10 Wiring interface co-ordination of equipment supplied by others.
- .11 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:
- .1 Design and provide conduit and wiring linking elements of system.
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Consultant prior to installation.
- .3 Location of controllers as reviewed by Consultant prior to installation.
- .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
- .5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:
- .1 Provide English operator selectable access codes.
- .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
- .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
- .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
- .5 Include, in English:
  - .1 Input and output commands and messages from operator-initiated functions as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

.6 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall not in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller. Each dedicated controller to have a locally mounted control and display device to allow the operator to view and adjust any point on the controller.

.7 All wiring associated with the EMCS communication network as well as all control wiring and conduit associated with the EMCS at 50 volts or less. Wire and conduit above 50 volts by Electrical Division.

.8 BACnet compliance: full compliance to the BACnet standard (ANSA / ASHRAE) 135, BACnet - A Data communication protocol for Building Automation and Control Networks is mandatory. Down to the field device level, the EMCS system must meet BACnet standards for system architecture and administration, and use open protocols and user friendly programming and graphics. Install the EMCS installed to communicate at the supervisory layer to the WAN using the BACnet TCP/IP protocol implemented on Ethernet.

.9 The EMCS system for the building is to be accessible by designated personnel via the WAN for monitoring and programming purposes. The EMCS Contractor is to provide all the required hardware, software, gateways etc, needed to permit connection of the EMCS to the WAN. This shall include all hardware, software, programming, start-up and commissioning required. The Contractor is to supply and install all the required hardware and software on the operator workstation(s) located in Owner's facilities management department. In addition, an Intelliweb license to be provided allowing access directly to the system.

.5 New EMCS must connect and be fully intergratable with existing Johnson Metasys System.

.6 Standard of Acceptance: Johnson Controls Inc.

1.7 SUBMITTALS

.1 Make submittals in accordance with Division 01 - General Requirements.

.2 Submit for review:

.1 Equipment list within ten (10) days after award of contract.

.2 List existing field control devices to be re-used included in bid, along with unit price.

.3 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Consultant, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.
.7 Existing devices intended for re-use: submit test report.

1.8 QUALITY ASSURANCE

.1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
.3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
.5 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health, Safety and Emergency Response Procedures.
.6 Be able to provide factory trained personnel on site within two (2) working days notice or provide instructions on maintenance and emergency service on system.
.7 BACnet devices to bear BACnet testing laboratories BTL mark and listed on BACnet manufacturers association web site.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Consultant with schedule within 2 weeks after award of Contract.
.2 Waste Management and Disposal:
.1 Separate waste materials for reuse in accordance with Section 01 74 00 - Cleaning & Waste Management.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
.4 Separate for reuse and place in designated containers Steel waste in accordance with Waste Management Plan.
.5 Place materials defined as hazardous or toxic in designated containers.
.6 Handle and dispose of hazardous materials in accordance with Provincial Regulations.
.7 Label location of salvaged material's storage areas and provide barriers and security devices.
.8 Ensure emptied containers are sealed and stored safely.
.9 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
.10 Fold up metal banding, flatten and place in designated area for recycling.

1.10 EXISTING CONDITIONS - CONTROL COMPONENTS

.1 Utilize existing control wiring as indicated.
.2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
.1 Do not modify original design of existing devices without written permission from Consultant.
.2 Provide for new, properly designed device where re-usability of components is uncertain.
.3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
.1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Consultant.

.2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.4 Non-functioning items:
- .1 Provide with report specification sheets or written functional requirements to support findings.
- .2 Consultant will repair or replace existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Consultant.
- .1 Be responsible for items repaired or replaced by Consultant.
- .2 Be responsible for repair costs due to negligence or abuse of equipment.
- .3 Responsibility for existing devices terminates upon final acceptance of EMCS.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

2 Products

2.1 ACCEPTABLE SYSTEMS, MANUFACTURERS

.1 Proposed system to have communication capability utilizing BACnet Protocol.

.2 Panel to be NEMA rated to suit environmental requirements.

.3 Panels to have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.

.4 Wiring within panels to be contained within properly sized rigid PVC slotted wall wire duct. All wiring within the wire duct to be concealed with a non-slip cover.

.5 Terminations for the connection of power wiring, communication wiring and field mounted devices to be a properly identified terminal blocks mounted within the control panel.

.6 All control panels to be provided with an internally mounted 120 volt duplex power receptacle.

.7 All control panels to be identified with permanently mounted lamecoid tags to identify the control panel and the systems served by the control panel. Submit schedule of labels with shop drawing submission.

.8 Provide low voltage transformers in panels or elsewhere as required.

.9 Provide adaptors between metric and imperial components.

2.2 EQUIPMENT

.1 Control Network Protocol: to ASHRAE STD 135.

.2 Complete list of equipment and materials to be used on project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.3 ADAPTORS

.1 Provide adaptors between metric and imperial components.

3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations. Provide printed copy of recommendations with shop drawings or product data.

3.2 PAINTING

.1 Painting: in accordance with NEMA, supplemented as follows:

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
.3 Clean and prime exposed hangers, racks, fastenings, and other support components.
.4 Paint unfinished equipment installed indoors to NEMA

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes.
  .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.
.2 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.
  .1 Location of local office.
  .2 Description and location of installing and servicing technical staff.
  .3 Location and qualifications of programming design and programming support staff.
  .4 List of spare parts.
  .5 Location of spare parts stock.
  .6 Names of sub-contractors and site-specific key personnel.
  .7 Sketch of site-specific system architecture.
  .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  .9 Descriptive brochures.
  .10 Sample CDL and graphics (systems schematics).
  .11 Response time for each type of command and report.
  .12 Item-by-item statement of compliance.
  .13 Proof of demonstrated ability of system to communicate utilizing BACnet Protocol.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
.2 Submit preliminary design document within thirty (30) working days after tender closing and before contract award, for review by Consultant.
.3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
.5 Soft copy to be in AutoCAD - latest version and WordPerfect latest version format, structured using menu format for easy loading and retrieval on OWS.
.6 Submittals shall consist of:
  .1 Data sheets of all products.
  .2 Wiring and piping interconnection diagrams including panel and device power, and sources. List of materials of all proposed devices and equipment.
  .3 Software documentation.
  .4 Sequence of operation, in text form.
  .5 Application programs.
  .6 Controls schematics and system diagrams.

.7 Project installation schedule.
.8 Names of sub-trades working for the EMCS Contractor.
.9 Mounting support details for components installed in airflow, waterflow and steam systems.

.7 Submit shop drawings in a package which contains the various schedules and drawings which completely describe the control system installed. At a minimum the shop drawings package to contain the following items:
.1 Network drawing showing the network connection of all network control units, programmable control units, terminal control units and operator workstations to indicate the location of each of these elements.
.2 Schematic control diagram for each system being controlled. Where there are typical systems, a drawing is to be provided each system. This drawing to be on a AB sized sheet (11" x 17") and shall include a title block which includes as a minimum the drawing title, drawing number, project title, Contractor's name, Contractor's address & phone numbers, and a section to provide a record for revision information.
.3 The schematic control diagram to include a bill of materials which provides a list of all part numbers and descriptions for the control components on the drawing list to include field equipment as well as panel mounted components.
.4 The schematic control diagram to include a complete wiring diagram for all electrical connections, including motor starters, heating coils, coiling coils etc.
.5 The schematic control diagram to include a layout of the controls panels for each system. This layout to show the mounting of all panel equipment, including transformers, power supplies, controllers, transducers, sensors, relays, contactors and any other panel mounted equipment.
.6 The Contractor to include with the shop drawing submittal drawings, showing all wiring details for the connections of sensors, transducers, relays and contactors. These details to show terminal numbers and be referenced to the appropriate schedules and drawings.
.7 The Contractor to supply the shop drawing package a complete point schedule to show every point connected to the system. This schedule to be in a tabular format and provide the point identification, point type, wire tag, termination details reference, referenced drawings, device mounting location and device code numbers.
.8 The point schedule to provide at a minimum the following information on the software attributes of the point:
.1 Tag name - ex. EPT-1
.2 Point type - ex. AO-3
.3 System name - ex. A/C-1
.4 Object name - H-VLV
.5 Expanded ID - Heating control valve.
.6 Units of measurement - %.
.9 The point schedule to provide at a minimum the following information on the digital controller to which the point is connected:
.1 Controller type - ex. Unitary controller.
.2 Controller address - ex. 256
.3 Cable destination - the termination at the controller, ex. AO-1
.4 Terminal numbers - the termination at the controller.
.10 The point schedule to provide at a minimum the following information on the control panel:
.1 Panel identification
.2 Panel location
.3 Reference drawing
.11 The point schedule to provide at a minimum the following information on any intermediate device which may be associated with the point:
.1 Type of wiring or tubing used

.2 Device part number
.3 Location of the device
.4 Reference details

.12 The point schedule to provide at a minimum the following information on any field device which may be associated with the point:
.1 Type of wiring or tubing used
.2 Device part number
.3 Location of the devices
.4 Reference details

.13 The Contractor to supply with the shop drawing package a complete room schedule, to show the equipment associated with the room controls. Schedule to be in tabular format and provide the room number and location, terminal unit number, part numbers for the terminal unit controller, sensors and actuators. Included on this schedule terminal unit type, size, minimum flow and maximum flow.

.14 Sequence of operation for each system controlled. Sequence to be in complete conformance with the sequence of operations included with this specification. Any changes require the approval of the Owner's Representative in writing. Sequence to include all modes of operation including fail safe, emergency and fire modes.

.15 Valve schedule including design flow, CV, size, type, actuator, pressure drop and maximum shut off pressure differential for each control valve.

.16 Damper schedule including design air flow, size, type, actuator and pressure drop and maximum shut off pressure differential for each control valve.

.17 Provide one (1) permanent, not fading, as-built copy of each control drawing, enclosed by an aluminium frame with glass cover, or sealed by plastic laminate in rigid metal bound frame. To be installed at each respective control panel location.

.18 Catalogue cut sheets of all equipment used. This includes, but is not limited to DDC panels, peripherals, sensors, actuators, dampers, control air system components etc.

.19 Range and scale information for all transmitters and sensors. This sheet to clearly indicate one (1) device and any applicable options. Where more than one (1) device to be used is on a singe sheet, submit two (2) sheets - individually marked.

.20 Hardware data sheets for all operator workstations, local access panels and portable operator terminals.

.21 Software manuals for all applications programs to be provided as a part of the operator workstations, portable operator terminals, programming devices and so forth for.

1.6 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
.2 Detailed system architecture showing all points associated with each controller including signal levels and pressures where new EMCS ties into existing control equipment.
.3 Spare point capacity of each controller by number and type.
.4 Controller locations.
.5 Auxiliary control cabinet locations.
.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
.10 Compressor schematic and sizing data.

1.7 DETAIL SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within sixty (60) working days after award of contract and before start of installation and include following:
  .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  .2 Wiring diagrams.
  .3 Piping diagrams and hook-ups.
  .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    .1 Sensing element type and location.
    .2 Transmitter type and range.
    .3 Associated field wiring schematics, schedules and terminations.
    .4 Complete Point Name Lists.
    .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
    .6 Software and programming details associated with each point.
    .7 Manufacturer's recommended installation instructions and procedures.
    .8 Input and output signal levels or pressures where new system ties into existing control equipment.
  .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
  .7 Graphic system schematic displays of air systems with point identifiers and textual description of system, and typical floor plans as specified.
  .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
  .9 Listing and example of specified reports.
  .10 Listing of time of day schedules.
  .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
  .12 Type and size of memory with statement of spare memory capacity.
  .13 Full description of software programs provided.
  .14 Sample of "Operating Instructions Manual" to be used for training purposes.
  .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.8 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.
.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
.3 Review interface requirements of materials supplied by others.
.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Consultant retains right to revise sequence or subsequent CDL prior to software finalization without cost to Consultant.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes.
  .1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.
.2 Section 25 05 02 - EMCS: Submittals and Review Process.
.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.3 DEFINITIONS

.1 BECC - Building Environmental Control Centre.
.2 OWS - Operator Work Station.
.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
.2 Submit Record Documents to Consultant in English.
.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  .1 Binders to be 2/3 maximum full.
  .2 Provide index to full volume in each binder.
  .3 Identify contents of each manual on cover and spine.
  .4 Provide Table of Contents in each manual.
  .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.5 AS-BUILTS

.1 Provide one (1) copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  .1 Changes to contract documents as well as addenda and contract extras.
  .2 Changes to interface wiring.
  .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
  .4 Locations of obscure devices to be indicated on drawings.
  .5 Listing of alarm messages.
  .6 Panel/circuit breaker number for sources of normal/emergency power.
  .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
  .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
  .9 Basic system design and full documentation on system configuration.
.2 Submit for final review by Consultant.
.3 Provide before acceptance four (4) hard and one (1) soft copy incorporating changes made during final review.

1.6 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide two (2) complete sets of hard and soft copies prior to system or equipment tests.

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

- .1 Functional description of theory of operation.
- .2 Design philosophy.
- .3 Specific functions of design philosophy and system.
- .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
- .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
- .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:

- .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
- .2 Operation of computer peripherals, input and output formats.
- .3 Emergency, alarm and failure recovery.
- .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:

- .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
- .2 Detailed descriptions of program requirements and capabilities.
- .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
- .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
- .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
- .6 Software for each Controller and single section referencing Controller common parameters and functions.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

- .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
- .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes.
  .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).
  .1 CSA C22.1, The Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

1.4 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.6 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
.2 Submit to Consultant for approval samples of nameplates, identification tags and list of proposed wording.

2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
.2 Sizes: 25 x 67 mm minimum.
.3 Lettering: minimum 7 mm high, black.
.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by chain.
.2 Sizes: 50 x 100 mm minimum.
.3 Lettering: minimum 5 mm high produced from laser printer in black.
.4 Data to include: point name and point address.
.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.
.2 Location: as directed by Consultant.
.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Consultant's.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

.1 Colour code EMCS conduit.
.2 Pre-paint box covers and conduit fittings.
.3 Coding: use fluorescent orange paint and confirm colour with Consultant during "Preliminary Design Review".

3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 07 84 00 - Firestopping.
.2 Section 23 05 00 - Common Work Results - Mechanical.
.3 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).
  .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
  .2 ANSI C2, National Electrical Safety Code.
  .3 ANSI/NFPA 70, National Electrical Code.
.2 Canadian Standards Association (CSA)
  .1 CSA C22.1, Canadian Electrical Code, Part 1.
  .2 CAN/CSA C22.3No.1, Overhead Systems.

1.3 SYSTEM DESCRIPTION

.1 Electrical:
  .1 Provide power wiring from emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
  .2 Hard wiring between field control devices and EMCS field panels.
  .3 Communication wiring between EMCS field panels and OWS including main control centre BECC.
  .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  .5 Refer to wiring diagrams included as part of flow diagrams in section. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by engineer before commencing work.
.2 Mechanical:
  .1 Pipe Taps required for EMCS equipment will be supplied and installed by Mechanical Piping Contractor.
  .2 Wells and Control Valves shall be supplied by EMCS Contractor and Installed by Mechanical Plumbing/Piping Contractor.
  .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Sheet Metal Contractor. Costs to be carried by designated trade.
.3 VAV Reheat Terminal Units:
  .1 Air flow probe for valve boxes to be supplied and installed under Section 23 36 00 - Air Terminal Units. Air flow dp sensor, actuator and associated valve controls to be supplied and installed by EMCS Contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS Contractor. Coordinate air flow adjustments with balancing trade.
.4 Structural:
  .1 Special steel work as required for installation of work.

1.4 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:
  .1 Continuously direct and monitor all work.
  .2 Attend site meetings.

1.5 EXISTING CONDITIONS

.1 Cutting and Patching: refer to Section 01 73 00 - Execution supplemented as specified herein.
.2 Repair all surfaces damaged during execution of work.
.3 Turn over to Engineer existing materials removed from work not identified for reuse.

2 Products

2.1 SPECIAL SUPPORTS

.1 Structural grade steel, primed and painted after construction and before installation.

2.2 WIRING

.1 As per requirements of Division 26.
.2 For 70V and above copper conductor with chemically cross linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
.3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
.4 Sizes:
  .1 120V Power supply: to match or exceed breaker, size #12 minimum.
  .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
  .3 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
  .4 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair. Wiring must be continuous without joints.
  .5 More than 4 conductors: #22 minimum solid copper.
.5 Terminations:
  .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.3 CONDUIT

.1 As per requirements of Division 26.
.2 Electrical metallic tubing to CSA C22.2 No .03. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.
.3 Junction and pull boxes: welded steel.
  .1 Surface mounting cast FS: screw on flat covers.
  .2 Flush mounting: covers with 25 mm minimum extension all round.
.4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
.5 Outlet boxes: 100 mm minimum, square.
.6 Conduit boxes, fittings:
  .1 Bushings and connectors: with nylon insulated throats.
  .2 With push pennies to prevent entry of foreign materials.
.7 Fittings for rigid conduit:
  .1 Couplings and fittings: threaded type steel.
  .2 Double locknuts and insulated bushings: use on sheet metal boxes.
  .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
.8 Fittings for thin wall conduit:
  .1 Connectors and couplings: steel, set screw type.

2.4 WIRING DEVICES, COVER PLATES

.1 Conform to CSA.
.2 Receptacles:

.1 Duplex: CSA type 5 15R.
.2 Single: CSA type 5 15R.
.3 Cover plates and blank plates: finish to match other plates in area.

2.5 STARTERS, CONTROL DEVICES

.1 Across the line magnetic starters:
  .1 Enclosures: CSA Type 1, except where otherwise specified.
  .2 Size, type and rating: to suit motors.
.2 Starter diagrams:
  .1 Provide copy of wiring and schematic diagrams mount one copy in each starter with additional copies for operation and maintenance manual.
.3 Auxiliary Control Devices:
  .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
  .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
  .3 Hand Off Automatic switch: heavy duty type, knob lever operator.
  .4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.
.4 Finish for starters:
  .1 Exterior: in accordance with Section 26 05 00 - Common Work Results - Electrical.
  .2 Interior: white.

2.6 SUPPORTS FOR CONDUITS, FASTENINGS, EQUIPMENT

.1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
  .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
.2 Exposed conduits or cables:
  .1 50 mm diameter and smaller: one hole steel straps.
  .2 Larger than 50 mm diameter: two hole steel straps.
.3 Suspended support systems:
  .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
  .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.2 MECHANICAL PIPING

.1 Install piping straight, parallel and close to building structure with required grades for drainage and venting.
.2 Ream ends of pipes before assembly.
.3 Copper tubing not to come into contact with dissimilar metal.
.4 Use non corrosive lubricant or Teflon tape on male screwed threads.
.5 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.
.6 Install dielectric couplings where dissimilar metals joined.
.7 Sleeves:
  .1 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
.2 Other floors: terminate 25 mm above finished floor.
.3 Before installation, paint exposed exterior surfaces with heavy application of zinc rich paint.

.2 Caulking:
.1 Foundation walls and below grade floors: fire retardant, waterproof non hardening mastic.
.2 Elsewhere: provide space for firestopping by Section 07 84 00 - Firestopping. Maintain fire rating integrity.
.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
.4 Ensure no contact between copper pipe or tube and sleeve.

.8 Pressure tests:
.1 Pressure test all piping systems modified under this contract to 1 1/2 times maximum working pressure or 860 kPa (whichever is greater) for 4 h without loss of pressure. Test all piping systems modified under this contract by means of visual inspection of each connection.
.2 Isolate equipment, components, not designed to withstand test pressure.

.9 Introduce system pressure carefully into new piping.

3.3 ELECTRICAL GENERAL

.1 Do complete installation in accordance with requirements of:
.1 Division 26, this specification.
.2 CSA 22.1 Canadian Electrical Code.
.3 ANSI/NFPA 70.
.4 ANSI C2.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Do underground installation to CAN/CSA C22.3 No.7, except where otherwise specified.

.4 Conform to manufacturer's recommendations for storage, handling and installation.

.5 Check factory connections and joints. Tighten where necessary to ensure continuity.

.6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

.8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

.9 Install conduits, and sleeves prior to pouring of concrete.

.10 Holes through exterior wall and roofs: flash and make weatherproof.

.11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.

.12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

.1 FT6 cable shall be allowed in lieu of conduit above ceilings. Cables installed in exposed ceiling and inside walls must be in conduit.

.2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.

.3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Engineer Consultant before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.

.4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
.5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
.6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
.7 Limit conduit length between pull boxes to less than 30 m.
.8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
.9 Fastenings and supports for conduits, cables, and equipment:
  .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
  .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
  .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Engineer Consultant.
.10 Install polypropylene fish cord in empty conduits for future use.
.11 Where conduits become blocked, remove and replace blocked sections.
.12 Pass conduits through structural members only after receipt of Engineer=s Consultant's written approval.
.13 Conduits may be run in flanged portion of structural steel.
.14 Group conduits wherever possible on suspended or surface channels.
.15 Pull boxes:
  .1 Install in inconspicuous but accessible locations.
  .2 Support boxes independently of connecting conduits.
  .3 Fill boxes with paper or foam to prevent entry of construction material.
  .4 Provide correct size of openings. Reducing washers not permitted.
  .5 Mark location of pull boxes on record drawings.
  .6 Identify AC power junction boxes, by panel and circuit breaker.
.16 Install terminal blocks or strips as specified by Division 26.
.17 Install bonding conductor for 120 volt and above in conduit.

3.5 WIRING

.1 Install multiple wiring in ducts simultaneously.
.2 Do not pull spliced wiring inside conduits or ducts.
.3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
.4 Tests: use only qualified personnel. Demonstrate that:
  .1 Circuits are continuous, free from shorts, unspecified grounds.
  .2 Resistance to ground of all circuits is greater than 50 Megohms.
.5 Provide Engineer Consultant with test results showing locations, circuits, results of tests.
.6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
.7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
.8 Do not allow wiring to come into direct physical contact with compression screw.
.9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 WIRING DEVICES, COVER PLATES

.1 Receptacles:
  .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
.2 Cover plates:
  .1 Install suitable common cover plate where wiring devices are grouped.
  .2 Use flush type cover plates only on flush type outlet boxes.

3.7 STARTERS, CONTROL, DEVICES

.1 Install and make power and control connections as indicated.
.2 Install correct over current devices.
.3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
.4 Performance Verification:
  .1 Operate switches and controls to verify functioning.
  .2 Perform start and stop sequences of contactors and relays.
  .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.8 GROUNDING

.1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
.2 Install separate grounding conductors in conduit within building.
.3 Install ground wire in all PVC ducts and in tunnel conduit systems.
.4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.9 TESTS

.1 General:
  .1 Perform following tests in addition to tests specified Section 25 08 20 EMCS: Warranty and Maintenance.
  .2 Give 14 days written notice of intention to test.
  .3 Conduct in presence of Engineer Consultant and authority having jurisdiction.
  .4 Conceal work only after tests satisfactorily completed.
  .5 Report results of tests to Engineer Consultant in writing.
  .6 Preliminary tests:
    .1 Conduct as directed to verify compliance with specified requirements.
    .2 Make needed changes, adjustments, replacements.
    .3 Insulation resistance tests:
      .1 Megger all circuits, feeders, equipment for 120 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
      .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Engineer Consultant and authority having jurisdiction.

3.10 IDENTIFICATION

.1 Refer to Section 25 05 54 - Mechanical Identification.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.
  .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCES

.1 Canada Labour Code (R.S, c. L-2)/Part I - Industrial Relations.
.2 Canadian Standards Association (CSA International).
  .1 CSA Z204, Guidelines for Managing Indoor Air Quality in Office Buildings.

1.4 DEFINITIONS

.1 BC(s) - Building Controller(s).
.2 OWS - Operator Work Station.
.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit detailed preventative maintenance schedule for system components to Consultant.
.3 Submit detailed inspection reports to Consultant.
.4 Submit dated, maintenance task lists to Consultant and include the following sensor and output point detail, as proof of system verification:
  .1 Point name and location.
  .2 Device type and range.
  .3 Measured value.
  .4 System displayed value.
  .5 Calibration detail
  .6 Indication if adjustment required,
  .7 Other action taken or recommended.
.5 Submit network analysis report showing results with detailed recommendations to correct problems found.
.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
  .1 Maintain records and logs of each maintenance task on site.
  .2 Organize cumulative records for each major component and for entire EMCS chronologically.
  .3 Submit records to Consultant, after inspection indicating that planned and systematic maintenance have been accomplished.
.7 Revise and submit to Consultant in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.6 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
.2 Emergency Service Calls:
  .1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
.3 Furnish Consultant with telephone number where service personnel may be reached at any time.
.4 Service personnel to be on site ready to service EMCS within two (2) hours after receiving request for service.
.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:
.1 Serial number identifying component involved.
.2 Location, date and time call received.
.3 Nature of trouble.
.4 Names of personnel assigned.
.5 Instructions of work to be done.
.6 Amount and nature of materials used.
.7 Time and date work started.
.8 Time and date of completion.

.5 Provide system modifications in writing.
.1 No system modification, including operating parameters and control settings, to be made without prior written approval of Consultant.

1.7 SERVICE CONTRACTS

.1 Provide in-depth technical expertise and assistance to Consultant and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.

.2 Service Contracts to include:
.1 Annual verification of field points for operation and calibration.
.2 Four (4) visits per year.
.3 Two (2) responses to emergency calls during day, per year.
.4 Two (2) responses to emergency calls during silent hours per year.
.5 Silent hours defined as 16:30 h to 08:00 h, and on weekends and statutory holidays.
.6 Complete inventory of installed system.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Consultant as described in Submittal article.

.2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.

.2 Check each field input/output device in accordance with Canada Labour Code - Part I.

.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:

.1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.

.2 Check equipment cooling fans as required.

.3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.

.4 Review system performance with Operations Supervisor to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:

.1 Minor inspection.

.2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

.3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.

.4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.

.5 Provide mechanical adjustments, and necessary maintenance on printers.

.6 Run system software diagnostics as required.

.7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.

.1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Section Includes:
- .1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
- .2 CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
- .1 IEEE Std 802.3TM, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
- .1 TIA/EIA-568, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
- .2 TIA/EIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.

.4 Treasury Board Information Technology Standard (TBITS).
- .1 TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.4 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

1.5 SYSTEM DESCRIPTION

.1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529.
- .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
- .2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:
- .1 EMCS-LAN.
- .2 Modems.
- .3 Network interface cards.
- .4 Network management hardware and software.
- .5 Network components necessary for complete network.

1.6 DESIGN REQUIREMENTS

.1 EMCS Local Area Network (EMCS-LAN).

.1 High speed, high performance, local area network over MS/TP with MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
.2 EMCS-LAN to: BACnet protocol.
.3 Each EMCS-LAN to be capable of supporting at least 50 devices.
.4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
.5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
.6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
.7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access.
.1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
.2 Access to data to be based upon logical identification of building equipment.

.3 Network Medium.
.1 Network medium: twisted cable, shielded twisted cable or fibre optic cable compatible with network protocol to be used within buildings. Fibre optic cable to be used between buildings.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Hardware and software requirements for an Operator Work Station (OWS) in a Building Energy Monitoring and Control System (EMCS), including primary, secondary, portable and remote OWS's.

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.
.2 Section 25 05 02 - EMCS: Submittals and Review Process.
.3 Section 25 05 03 - EMCS: Project Record Documents.
.4 Section 25 30 01 - EMCS: Building Controllers.
.5 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
.2 Secondary OWS: serves as backup to primary OWS, is storage and retrieval facility of soft copy of as-built contractor supplied data as described in Section 25 05 03 - EMCS: Project Record Documents.
.3 Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.
.4 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

1.4 OWS SYSTEM DESCRIPTION

.1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.
.2 Primary OWS to include:
  .1 Report printer.
  .2 Colour graphics printer.
  .3 Modem.
  .4 Desks, furniture.
.3 Secondary OWS.
.4 Remote auxiliary OWS.
.5 Portable Laptop.

1.5 SUBMITTALS

.1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.6 ENVIRONMENTAL CONDITIONS

.1 OWS to operate in conditions of 10 degrees C to 32 degrees C and 20 % to 90 % non-condensing RH.

1.7 MAINTENANCE

.1 Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

2 Products

2.1 OWS HARDWARE

.1 PC system to include:
- .1 Processor: Pentium IV micro-processor, operating at minimum clock speed of 2 Gigahertz, capable of supporting software necessary to perform functions specified in this section. System backplane bus (100 Megahertz) to support PCI and ISA boards.
- .2 Internal clock.
  - .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.
  - .2 Rechargeable batteries: to provide minimum 48 h clock operation in event of power failure.
- .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.

.2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.

.3 Include UPS to provide 5 minutes minimum operation of PC, CRT and communication and peripheral devices; applies to fixed (non portable) OWSs and peripherals.

2.2 OPERATING SYSTEM (OS) OR EXECUTIVE

.1 OS to support complement of hardware terminals and software programs specified.

.2 OS to be true multitasking operating environment.
- .1 MS DOS or PC DOS based software platforms not permitted.

.3 OWS software to operate in "Windows" based operating environment: Windows 2000, XP or Unix "X' Windows based system.

2.3 OWS CONTROL SOFTWARE

.1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.

.2 Time Synchronization Module.
- .1 System to provide Time Synchronization of real-time clocks in controllers.
- .2 System to perform this feature on regular scheduled basis and on operator request.

.3 User Display Interface Module.
- .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.
- .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.

.4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
- .1 Operator Log-in from user interface device.
- .2 Communication messages: errors, failures and recovery.
- .3 Event notifications and alarms by category.
- .4 Record of operator initiated commands.

.5 General Event Log:
- .1 Hold minimum of 4 months information and be readily accessible to operator.
- .2 Able to be archived as necessary to prevent loss of information.

.6 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
- .1 Automatic logging of digital alarms and change of status messages.
- .2 Automatic logging of analog alarms.
- .3 System changes: alarm limits, set-points, alarm lockouts.
- .4 Display specific point values, states as selected.
- .5 Provide reports as requested and on scheduled basis when required.
- .6 Display graphics as requested, and on alarm receptions (user's option).
- .7 Display list of points within system.
- .8 Display list of systems within building.
- .9 Direct output of information to selected peripheral device.
- .10 On-line changes:
  - .1 Alarm limits.
  - .2 Setpoints.
  - .3 Deadbands.
  - .4 Control and change of state changes.
  - .5 Time, day, month, year.
  - .6 Control loop configuration changes for controller-based CDLs.
  - .7 Control loop tuning changes.
  - .8 Schedule changes.
  - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
- .11 According to assigned user privileges (password definition) following functions are to be supported:
  - .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
  - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
- .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.

.7 Dial-up host Module for off site OWSs.
- .1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
- .2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.
- .3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.

.8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
- .1 Message and alarm buffering to prevent loss of information.
- .2 Error detection correction and retransmission to guarantee data integrity.

.3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.

.4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.

.9 Access Control Module.

.1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:

.1 Guest: no password data access and display only.

.2 Operator Level: full operational commands including automatic override.

.3 Technician: data base modifications.

.4 Programmer: data base generation.

.5 Highest Level: system administration - password assignment addition, modification.

.2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.

.10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.

.1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.

.2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 h basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.

.3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.

.4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.

.5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.

.11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01 - EMCS: Building Controllers.

.1 Reports to include time, day, month, year, report title, operator's initials.
.2 Software to provide capability to:
.1 Generate and format reports for graphical and numerical display from real time and stored data.
.2 Print and store reports as selected by operator.
.3 Select and assign points used in such reports.
.4 Sort output by area, system, as minimum.
.3 Periodic/automatic report:
.1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
.2 Reports to include:
.1 Power demand and duty cycle summary: see application program for same.
.2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
.3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
.4 Summary of run time alarms: include point name, run time to date, alarm limit.
.5 Summary of start/stop schedules: include start/stop times and days, point name.
.6 Motor status summary.
.4 Report types:
.1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
.1 Points in accessible from this OWS (total connected for this location), multiple "areas".
.2 Area (points and systems in Area).
.3 Area, system (points in system).
.4 System (points by system type).
.5 System point (points by system and point object type).
.6 Area point (points by system and point object type).
.7 Point (points by point object type).
.5 Summary report: printout or display of point objet data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
.6 Include preformatted reports as listed in Event/Alarm Module.

.12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
.1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlayed with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.

.2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.

.3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.

.4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:

.1 Modify portion of graphic picture/schematic background.
.2 Delete graphic picture.
.3 Call up and cancel display of graphic picture.
.4 Define symbols.
.5 Position and size symbols.
.6 Define background screens.
.7 Define connecting lines, curves.
.8 Locate, orient, size descriptive text.
.9 Define, display colours of elements.
.10 Establish co-relation between symbols or text and associated system points or other graphic displays.

.5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.

.6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.

.7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2 OWS's.

.8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Consultant. In addition provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Consultant to provide CAD floor layouts. Provide display of TCU -VAV's in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.

.9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click to activate selected graphic.

.10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain English language.

.13 Event/Alarm Module: displays in window alarms as received and stored in General Event Log.

.1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
.2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
.3 Alarm reports.
.1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
.2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
.3 Summary of alarm messages: include associated point name, alarm description.
.4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
.5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:
.1 Critical - 5 seconds.
.2 Cautionary - 10 seconds.
.3 Maintenance - 10 seconds.
.6 Display alarm messages in English.
.7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
.8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgment of one alarm as acknowledgement of other alarms.
.9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
.1 Controller not responding - where possible delineate between controller and communication line failure.
.2 Controller responding - return to normal.
.3 Controller communications bad - high error rate or loss of communication.
.4 Controller communications normal - return to normal.
.10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.

.14 Archiving and Restoration Module.
.1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.
.2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.

.3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.

.15 CDL Generator and Modifier Module.

.1 CDL Generator module to permit generation and modification of CDLs.

.2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.

.3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.

.4 Module to permit testing of code before downloading to building controllers.

2.4 ADDITIONAL UTILITY SOFTWARE

.1 Supply and install on primary OWS, following CAD software products by Autodesk Inc. and include:

.1 AutoCAD LT latest version.

.2 Include special drivers, fonts, to ensure complete and proper functioning of software packages specified. Deliver system complete with full set of User Manuals.

.3 Enter soft copy submissions, including "Record" drawings specified in Section 25 05 03 - EMCS: Project Record Documents in OWS.

.4 Enter soft copy of Architectural, Electrical, Mechanical systems plans and "Record" drawings in OWS. Plans and drawings to be provided by Consultant.

3 Execution

3.1 INSTALLATION REQUIREMENTS

.1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.

.1 Install tamper locks on breakers of circuit panels.

.2 Refer to UPS requirements stated under OWS Hardware in PART 2.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation for building automation controllers including:
  - .1 Master Control Unit (MCU).
  - .2 Local Control Unit (LCU).
  - .3 Equipment Control Unit (ECU).
  - .4 Terminal Control Unit (TCU).

1.2 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.
.2 Section 25 05 02 - EMCS: Submittals and Review Process.
.3 Section 25 05 03 - EMCS: Project Record Documents.
.4 Section 25 30 02 - EMCS: Field Control Devices.
.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
- .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
  - .1 C22.2 No.205-M1983(R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

1.4 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
- .1 Provide sufficient controllers to meet intents and requirements of this section.
- .2 Controller quantity, and point contents to be approved by Consultant at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.
- .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
- .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
- .3 Capable of interfacing with operator interface device.
- .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
- .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
- .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.6 DESIGN REQUIREMENTS

.1 To include:
- .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
- .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
- .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
- .4 Control of systems as described in sequence of operations.
- .5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:
- .1 To: CSA C22.2 No.205.
- .2 Electronically interface sensors and control devices to processor unit.
- .3 Include, but not be limited to, following:
  - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
  - .2 Power supplies for operation of logics devices and associated field equipment.
  - .3 Lockable wall cabinet.
  - .4 Required communications equipment and wiring (if remote units).
  - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
  - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
  - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
  - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
  - .2 Provide for following input signal types and ranges:
    - .1 4 - 20 mA;
    - .2 0 - 10 V DC;
    - .3 100/1000 ohm RTD input;
  - .3 Meet IEEE C37.90.1 surge withstand capability.
  - .4 Have common mode signal rejection greater than 60 dB to Hz.
  - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:
.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
.2 Meet IEEE C37.90.1 surge withstand capability.
.3 Accept pulsed inputs up to 2 kHz.
.7 DO interface equipment:
.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
.1 Provide for conduit entrance from top, bottom or sides of panel.
.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
.3 Mounting details as approved by Consultant for ceiling mounting.
.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.7 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.1 Submit product data sheets for each product item proposed for this project.

1.8 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
.1 MCU must support Proprietary Protocol.
.3 MCU local I/O capacity as follows:
.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
.2 LCUs may be added to support system functions.
.4 Central Processing Unit (CPU).
.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum hour operation in event of power failure.

.5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Consultant.

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.
.2 Modify setpoints.
.3 Modify PID loop parameters.
.4 Override PID control.
.5 Change time/date.
.6 Add/modify/start/stop weekly scheduling.
.7 Add/modify setpoint weekly scheduling.
.8 Enter temporary override schedules.
.9 Define holiday schedules.
.10 View analog limits.
.11 Enter/modify analog warning limits.
.12 Enter/modify analog alarm limits.
.13 Enter/modify analog differentials.

.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
.4 Include power supplies for operation of LCU and associated field equipment.
.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
.6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
  .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
  .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
  .3 VAV Terminal Controller.
    .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
    .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
    .3 Controller to operate independent of network in case of communication failure.
    .4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 SOFTWARE

.1 General.
  .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
  .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
  .3 Include initial programming of Controllers, for entire system.
.2 Program and data storage.
  .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
  .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
.3 Programming languages.
  .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
  .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Consultant.
.4 Operator Terminal interface.
  .1 Operating and control functions include:
    .1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.
.3 Operator commands.
.4 Reports.
.5 Displays.
.6 Point identification.

.5 Pseudo or calculated points.
.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):
.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
.3 Perform changes to CDL on-line.
.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
.6 MCU to be able to perform following pre-tested control algorithms:
.1 Two position control.
.2 Proportional Integral and Derivative (PID) control.
.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
.1 Time of day scheduling.

.2 Calendar based scheduling.
.3 Holiday scheduling.
.4 Temporary schedule overrides.
.5 Optimal start stop.
.6 Night setback control.
.7 Enthalpy (economizer) switchover.
.8 Peak demand limiting.
.9 Temperature compensated load rolling.
.10 Fan speed/flow rate control.
.11 Cold deck reset.
.12 Hot deck reset.
.13 Hot water reset.
.14 Chilled water reset.
.15 Condenser water reset.
.16 Chiller sequencing.
.17 Night purge.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
.3 Apply programs to equipment and systems as specified or requested by the Consultant.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
.1 MCUs to accumulate and store automatically run-time for binary input and output points.
.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (e.g. kWH, litres, tonnes, etc.).
.6 Store event totalization records with minimum of 9,999,999 events before reset.
.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
.1 Display analog values digitally to 1 place of decimals with negative sign as required.
.2 Update displayed analog values and status when new values received.
.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Consultant.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as indicated.
.2 Provide necessary power from local 120V branch circuit panel for equipment.
.3 Install tamper locks on breakers of circuit breaker panel.
.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and coordinating mode.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters.

1.2 RELATED SECTIONS

.1 Section 07 84 00 - Firestopping.
.2 Section 23 33 15 - Dampers - Operating.
.3 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
.4 Section 25 05 01 - EMCS: General Requirements.
.5 Section 25 05 02 - EMCS: Submittals and Review Process.
.6 Section 25 05 54 - EMCS: Identification.
.7 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
.8 Section 26 05 00 - Common Work Results - Electrical.
.9 Section 26 27 10 - Modular Wiring System.
.10 Section 26 27 26 - Wiring Devices.

1.3 REFERENCES

.1 American National Standards Institute (ANSI).
- .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
- .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).
- .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).
- .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).
- .1 CSA-C22.1-21, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.4 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
.2 Pre-Installation Tests.
- .1 Submit samples at random from equipment shipped, as requested by Consultant, for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.6 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Division 01 - General Requirements supplemented as specified herein.
.2 Repair surfaces damaged during execution of Work.
.3 Turn over to Consultant existing materials removed from Work not identified for re-use.

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, shockproof, vibration-proof, heat resistant, 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, 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: except for room sensors to be resistance or thermocouple type to following requirements:
  .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: copper or 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 100 mm as indicated.
.2 Room temperature sensors and display wall modules.
  .1 Temperature sensing and display wall module.
    .1 LCD display to show space temperature and temperature setpoint.
    .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
    .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit for access to zone bus.
    .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.
  .2 Room temperature sensors.
    .1 Wall mounting, in slotted type covers having brushed stainless steel finish, with guard as indicated.
    .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, insertion length 460 mm or.

.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 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

.3 Output signal: 4 - 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.

.10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.

.11 Transmitter ranges: select narrowest range to suit application from following:

.1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

.2 0 to 100 degrees C, plus or minus 0.5 degrees C.

.3 0 to 50 degrees C, plus or minus 0.25 degrees C.

.4 0 to 25 degrees C, plus or minus 0.1 degrees C.

.5 10 to 35 degrees C, plus or minus 0.25 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 2 %.

.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: locate in air stream near RA grille as indicated.

.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 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:
.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 Integral zero and span adjustment.
.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
.7 Over-pressure input protection to at least twice rated input pressure.
.8 Output short circuit and open circuit protection.
.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 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.

2.9 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

2.10 VELOCITY PRESSURE SENSORS

.1 Requirements:
.1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
.2 Maximum pressure loss: 37Pa at 1000 m/s.
.3 Accuracy: plus or minus 1 % of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

.1 Requirements:
.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
.2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
.3 Accuracy: 0.4 % of span.
.4 Repeatability: within 0.1 % of output.
.5 Linearity: within 0.5 % 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.

2.12 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.
.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.

2.13 TEMPERATURE SWITCHES

.1 Requirements:
.1 Operate automatically. Reset automatically, except as follows:
.1 Low temperature detection: manual reset.
.2 High temperature detection: manual reset.
.2 Adjustable setpoint and differential.
.3 Accuracy: plus or minus 1 degrees C.
.4 Snap action rating: 120V, 15 amps as required. Switch to be DPST for hardwire and EMCS connections.
.5 Type as follows:
.1 Room: for wall mounting on standard electrical box with protective guard as indicated.
.2 Duct, general purpose: insertion length = 460 mm.
.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
.4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
.5 Strap-on: with helical screw stainless steel clamp.

2.14 TANK LEVEL SWITCHES

.1 Requirements:
- .1 Indicate high/low water level and to alarm.
- .2 For mounting on top of tank.
- .3 Maximum operating temperature: 120 degrees C.
- .4 Snap action contacts rated 15 amp at 120 V.
- .5 Adjustable setpoint and differential.

2.15 SUMP LEVEL SWITCHES

.1 Requirements:
- .1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
- .2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.
- .3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC.

2.16 WIND VELOCITY TRANSMITTERS

.1 Requirements:
- .1 3-cup anemometer and airfoil vane mounted on common vertical axis, designed for mast mounting.
- .2 Anemometer:
  - .1 Range: 0-160 km/h.
  - .2 Threshold: 3.0 km/h.
  - .3 Accuracy: +/- 2%.
- .3 Airfoil vane
  - .1 Range: 0-360 degrees with infinite resolution potentiometer with no loss of reading at transition point.
  - .2 Starting threshold: 1.1 M/s.
  - .3 Accuracy: +/- 0.5%.
  - .4 Output signals: 4 to 20Ma into 500 ohm load.
  - .5 Provide two output signals: velocity, direction.
  - .6 Mast: aluminum, size and height as indicated.
    - .1 Provide at least 3 stainless steel guys, turnbuckles, anchor bolts. Follow manufacturers installation guidelines.
    - .2 Lightning protection as indicated on electrical drawings.

2.17 SOLAR SENSORS

.1 Monitor solar radiation as indicated.

.2 Pyranometer, black and white, producing proportional 0-50 mV signal. Include converter for 4-20 mA signal.

2.18 ELECTROMECHANICAL RELAYS

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

2.19 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.

2.20 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.

2.21 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.

2.22 CONTROL DAMPERS

.1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 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, zinc and nickel plated steel.
.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/m2 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.

2.23 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 Operating range: 0 - 10 V DC or 4 - 20 mA DC.

.6 For VAV box applications floating control type actuators may be used.

.7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.24 CONTROL VALVES

.1 Body: globe style, characterized ball.

.1 Flow characteristic as indicated on control valve schedule: linear.

.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.3 Normally open, as indicated.

.4 Two port, as indicated.

.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, stainless steel, brass, 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 2(and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

.2 Butterfly Valves NPS 2 and larger:

.1 Body: for chilled water ANSI Class 150 cast iron lugged body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body.

.2 End connections to suit flanges that are ANSI Class 150.

.3 Extended stem neck to provide adequate clearance for flanges and insulation.

.4 Pressure limit: bubble tight sealing to 170 kilopascals.

.5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B148.

.6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).

.7 Stem: 316 stainless steel.
.8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
.9 Flow characteristic linear.
.10 Maximum flow requirement as indicated on control valve schedule.
.11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
.12 Normally open, as indicated.
.13 Valves are to be provided complete with mounting plate for installation of actuators.

2.25 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:
.1 Construction: steel, cast iron, aluminum.
.2 Control signal: 0-10V 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.

2.26 WATTHOUR METERS AND CURRENT TRANSFORMERS

.1 Requirements:
.1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watt hour meter use. Accuracy: plus or minus 0.25 % of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.
.2 Watthour meter sockets: to ANSI C12.7.
.3 Potential and current transformers: to ANSI/IEEE C57.13.
.4 Potential transformers: provide two primary fuses.
.5 Demand meters: configure to measure demand at 15 minute intervals.

2.27 SURFACE WATER DETECTORS

.1 Requirements:
.1 Provide alarm on presence of water on floor.
.2 Expendable cartridge sensor.
.3 Internal waterproof switch.
.4 One set of dry contacts 2 amps at 24 V.
.5 Unaffected by moisture in air.
.6 Self-powered.

2.28 PANELS

.1 Free-standing enamelled steel cabinets with hinged and key-locked front door.
.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Consultant without adding additional cabinets.
.3 Panels to be lockable with same key.

2.29 WIRING

.1 In accordance with Section 26 27 10 - Modular Wiring System.
.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: #18AWG.
.2 Analog input and output: shielded #18 minimum solid copper.

2.30 PARKING GARAGE GAS DETECTION SYSTEM

.1 Functional description of CO and NO2 monitoring system.
  .1 Detection by sensor(s), the system shall perform the following:
    .1 Activate ventilation.
    .2 Activate audio and visual alarm.
    .3 Notify Building Automation System of alarm condition.
.2 Refrigerant Monitor:
  .1 Basis-of-Design Product: The design is based on Honeywell Analytics (Vulcain) Self Contained Module VA301. Provide either the named product or an approved equal.
  .2 Description: Electrochemical (diffusion) type sensor shall continuously measure and display the specific gas concentration and shall be capable of indicating, alarming, and shutting down equipment, and automatically activating building ventilation system.
  .3 Performance Requirements:
    .1 Gas to be Monitored: CO and NO2
    .2 Gas Concentration: CO = 0 to 250 ppm / NO2 = 0 to 10 ppm.
    .3 Accuracy: plus or minus 3 percent of reading, full scale.
    .4 Sensitivity: CO = 1 ppm / NO2 = 0.1 ppm.
    .5 Stability: The 30 day zero or span drift must be less than 1 percent F.S. without the aid of automatic or manual recalibration.
    .6 Operating Temperature: -30 to 50 deg C.
    .7 Relatively Humidity: 20 to 95 percent, noncondensing over the operating temperature range.
  .4 Operating Requirements:
    .1 Power Input: System operates on Direct Current (DC). Provide power supply from 120-V ac; 60 Hz as recommended by manufacturer. This contractor remains financially responsible for providing 120V power to this power supply.
    .2 Alarm Set Point Levels: Provide two separate alarm set point levels. The set points shall be independently adjustable for any value for a given range. The set points shall provide drive signals to user interface relays. Alarm set points shall have the capability of providing the user a selection of latching or non-latching.
    .3 Relay Outputs: Alarm set point drive signals shall activate user relays as follows:
    .4 Number of Relays: As a minimum, 1 relay for each alarm set point.
    .5 Contact Rating: Form C, single pole, double throw. Dry contacts shall be rated for 8 amps resistive at 120 VAC.
    .6 Contact Selection: The contacts shall be capable of being selected normally energized or non-energized, latching or non- latching.
    .7 Alarm Set Points: Displayed on front of monitor.
    .8 Audible Output: Sonic alert at 85 dB at 60 inches.
    .9 Analog Output: 0- to 10-V dc or 4- to 20-mA current sourcing.
    .10 Serial Output Type: RS 485.
  .5 Sensor Configuration: Electrochemical (diffusion) type sensor that works in conjunction with readout or alarm unit.
  .6 Display: alphanumeric display; indicating lights for each alarm set point; standard alarm; acknowledge switch and test switch mounted on front panel; gas concentration, diagnostics, set-up, calibration menu, alarm status LEDs and service fault LEDs. Display alarm indications on the front display panel.
    .1 Enclosure: NEMA 4X.

.7 Alarm Output: Indicating light flashes and horn sounds.
- .1 Unit-mounting device with single-light beacon and horn; factory mounted and wired.
- .2 Remote units for mounting outside machinery room and having light beacon with single light at each building entry door.
- .3 Field-adjustable alarm set points.

.8 Calibration: Factory calibrated system that has a menu driven method of checking both zero and span calibration. Adjustments shall be made through front panel keypad.

.9 Malfunction Indication: The readout display shall display full diagnostics when fault exists without use of codes.

.10 Front Panel Controls: Functions specified shall be accomplished using a keypad readily accessible on the front panel. No tool or adapters shall be used for:
- .1 Display of alarm set point level or readout display.
- .2 Resetting any alarm point set.
- .3 Zero and span calibration adjustments.

.11 Sample Gas Filter: There shall be an internal sample gas filter. Filter shall be easily serviced or replaced.

.12 Sequencer Programming Limits:
- .1 System parameters shall be within the following:
- .2 Point Dwell Time: 30 seconds.
- .3 Alarm Levels:
  - .1 CO = 50 ppm (adj.) / NO2 = 1.5 ppm (adj.) – Activate audiable and visual alarms, start ventilation.
  - .2 CO = 100 ppm (adj.) / NO2 = 3 ppm (adj.) – Shutdown refrigeration equipment.
- .4 Alarm: Provide 2 alarm set point levels. Any alarm set point shall be capable of activating 1 relay (SPDT, 8 amp at 120 VAC, resistive).
- .5 Indicating Lights: All indications related to the multipoint sequencer shall appear on the front panel display.

.13 Maximum System Maintenance Requirements: System shall require no periodic maintenance other than periodic checking. Periodic checking or adjustments of the unit shall be capable of being accomplished by one person at the unit location.

.14 Manufacturer Capability Requirements: As a minimum, the refrigerant monitor equipment manufacturer shall be capable of the following:

.3 Signage:
- .1 Engraved Plastic Laminate: Engrave through exposed face ply of plastic- laminate sheet to expose contrasting core ply.
  - .1 Face ply shall be red, core shall be white.
- .2 Graphic Content and Style:
  - .1 Font Style: Upper case helvetica or arial.

.2 Content: As follows: Phone numbers of Energy Center and Security will be as directed by the Owner.

CO / NO2 CARBON MONOTIDEL NITROGEN DIOXIDE

GREEN - NORMAL AMBER - FAULT - SERVICE REQUIRED
AMBER - FAULT - SERVICE REQUIRED
RED - DANGER - HIGH LEVEL LEAK DETECTED - UNSAFE TO ENTER MECHANICAL ROOM

NOTIFY ENERGY CENTER (ph #) OR SECURITY (ph #) IMMEDIATELY UPON INDICATION OF ANY ALARM.

.4 Verify that refrigerants for this signage are refrigerants in use for the facility.

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 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.
.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
.5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
.6 Electrical:
  .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.
  .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Consultant before beginning Work.
  .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
  .5 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.
  .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Consultant to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
.7 Mechanical: supply and install of the following:

.1 Pipe Taps.
.2 Wells and Control Valves.
.3 Air flow stations, dampers, and other devices.

.8 VAV Terminal Units: supply, install and adjust as required.
.1 Air probe, actuator and associated vav controls.
.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
.3 Co-ordinate air flow adjustments with balancing trade.

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 MAGNEHELIC PRESSURE INDICATORS

.1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Consultant.
.2 Locations: as indicated.

3.5 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.

3.6 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.7 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.

3.8 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.9 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

1 General

1.1 DESCRIPTION

.1 This specification describes a high performance variable frequency drive (VFD) used to control the speed of a NEMA design B induction motor.
.2 Load filters shall be supplied with all drives.
.3 A building automation system serial communication module and EMCS communication card shall be supplied with all drives.

1.2 REFERENCES

.1 Institute of Electrical and Electronic Engineers (IEEE)
  .1 S
.2 Underwriters laboratories (ULC)
  .1 UL508C Power Conversion Equipment
.3 National Electrical Manufacturer's Association (NEMA)
  .1 ICS 7.0, AC Adjustable Speed Drivers
.4 International ElectroTechnical Commission (IEC)
  .1 IEC 61800 Adjustable Speed Electrical Power Drive Systems.
.5 International Standards Organization (ISO)
  .1 ISO-9001 Quality Management Systems.

1.3 SUBMITTALS

.1 Submittals shall include the following information:
  .1 Outline dimensions, conduit entry locations and weight.
  .2 Customer connection and power wiring diagrams.
  .3 Complete technical product description include a complete list of options provided.
  .4 Compliance to IEEE 519 - harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
    .1 The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, no exceptions.
  .5 All in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

.1 The VFD manufacturing facility shall be ISO 9001 certified. The VFD shall be UL listed, Canadian UL listed, CSA listed, IEEE listed, and NEMA listed.
.2 All printed circuited boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a preliminary functional test, burn-in, and computerized final test. The burn-in shall be at 40°C, at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation. Conformal coating of boards shall be included for each drive.
.3 The drive shall be designed to provide 250 000 hours mean time before failure (MTBF) when the specified preventative maintenance is performed.
.4 VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray components, and decap or delaminate components and analyze failures within the component.

2 Products

2.1 VARIABLE FREQUENCY DRIVES

.1 The VFD package as specified herein shall be enclosed in a NEMA Type 4 enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

.1 Environmental operating conditions: 0°C to 40°C continuous duty. VFD's that can operate at 40 C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 1000m above sea level, less than 95% humidity, non-condensing.

.2 Enclosure shall be type NEMA 4. VFD's without these ratings are not acceptable.

.2 All VFD's shall have the following standard features:

.1 All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.

.2 The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

.3 There shall be a built-in time clock in the VFD keypad. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays.

.4 The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.

.5 The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

.6 The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

.7 The VFD shall have an integral 5% impedance reactor to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add AC line reactors.

.8 The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

.9 The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signalling a false underload condition.

.10 If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

.3 All VFD's to have the following adjustments:

.1 Two (2) PID Setpoint controllers shall be standard in the drive. Two (2) programmable analog inputs shall accept current or voltage signals.

.2 Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to frequency, motor speed, output voltage, output current, motor torque, motor power (kW), DC bus voltage, active reference, and other data.

.3 Six (6) programmable digital inputs. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications) the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety status shall also be transmitted over the serial communications bus. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.

.4 Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. Default settings shall be for run, not faulted (fail safe), and run permissive. The relays shall be rated for maximum switching current 6 amps at 30 VDC and 250 VAC and 0.4 A at 120 VDC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable.

.5 The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

.6 The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.

3 Execution

3.1 INSTALLATION

.1 Installation shall be the responsibility of the EMCS contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

.2 Power wiring shall be completed by the electrical contractor. Three copper conductors and a ground wire are required. Separate the input power wiring from the output power wiring in individual metallic conduit. Do not combine. Provide a separate metallic conduit for control wiring. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

.1 Certified factory start-up shall be provided for each drive by a factory authorized service center in accordance with Section 01 91 13 - Commissioning (Cx) Requirements and Section 26 05 00 Common Work Results - Electrical. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

.1 Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A 24/365 technical support line shall be available on a toll-free line.

3.4 WARRANTY

.1 Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

END OF SECTION

1 General

1.1 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.

1.2 AIR SYSTEMS

.1 Constant Volume - Terminal Unit

.1 Run conditions - continuous.

.1 The unit shall run continuously and shall maintain:

.1 A 75°F (adj.) cooling setpoint.

.2 A 70°F (adj.) heating setpoint.

.2 Alarms shall be provided as follows:

.1 High Zone Temp:

.1 If zone temperature is greater than the cooling setpoint by a user definable amount (adj.).

.2 Low Zone Temp:

.1 If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

.3 Zone Setpoint Adjust:

.1 The Hospital Personnel shall be able to adjust the zone temperature heading and cooling setpoints through the GUI. Temperature sensor shall be provided to monitor room temperature..

.4 Flow Control:

.5 The unit shall maintain constant airflow through one of the following:

.1 Occupied:

.1 The zone damper shall modulate to maintain a constant occupied airflow (adj.) distributed into the zone.

.2 Unoccupied:

.1 The zone damper shall modulate to maintain a constant unoccupied airflow (adj.) distributed into the zone.

.2 When zone temperature is less than its heating setpoint, the controller shall enable heating to maintain the zone temperature at its unoccupied heating setpoint.

.6 Reheating Coil Valve:

.1 The controller shall measure the zone temperature and modulate the reheating coil valve open on dropping temperature to maintain its heating setpoint.

.7 Discharge Air Temperature:

.1 The controller shall monitor the discharge air temperature.

.2 Alarms shall be provided as follows:

.1 High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).

.2 Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

1.3 HEATING SYSTEM

.1 Heating Pumps (typical for all heating pump sets):
- .1 One heating pump operates on any one (1) zone calling for heat. If the lead pump stops or fails to start, the standby pump is started and an alarm is generated in the EMCS. Provide the capability to alternate the lead pump manually or by time schedule. Provide current sensing relays for pump status.

.2 Reheat Box Controls:
- .1 DDC controller shall modulate the reheat valve to maintain the room temperature.

.3 Control of Reheat Box, Perimeter Heater:
- .1 DDC controller shall modulate the reheat coil to maintain the room temperature.

.4 Infloor Radiant Heating:
- .1 On drop in room temperature, space thermostat shall modulate the control valve on in-floor heat manifold open. On rise in room temperature, the reverse sequence shall follow.
- .2 Infloor Heating valves shall open and close to maintain slab temperature between 16°C and 18°C when outdoor air temperature is below 10°C.

1.4 MISCELLANEOUS VENTILATION EXHAUST SYSTEMS (EF-1)

.1 Typical exhaust fans:
- .1 Each fan shall operate by EMCS time schedule.
- .2 An alarm shall be generated if an exhaust fan that is intended to operate continuously, as noted above, is stopped including conditions when the fan is commanded off via the EMCS.

1.5 EXHAUST FANS (EF-2)

.1 EF-2 (Parking Area - typical of 2)
- .1 Run Conditions: The exhaust fan shall run when one, or both, of the following events occur:
  - .1 Upon detection of carbon monoxide levels above 50ppm (adj.) or nitrogen dioxide levels above 1.5ppm (adj.) by the packaged gas detection system. When this low level alarm is initiated, the gas detection system shall initiate its low level LED visual alarm and both fans shall run at low speed. If the zone carbon monoxide reaches 100ppm (adj.) or nitrogen dioxide is reaches 2ppm (adj.) the gas detector shall initiate its High Level audible and visual alarms. Both fans shall operate at high speed.
  - .2 A user definable EMCS schedule commands one (1) or both exhaust fans to run at low speed (50% adj.). Controls shall be provided to allow selection of the lead exhaust fan. EMCS schedule shall be configured by this contractor only when the owner believes operating conditions require some amount of scheduled airflow through the parking area. This contractor shall allow time to configure this programming and train the owner's representative at least 2 months after the owner occupies the building under full operation.
- .2 Exhaust Fan Speed Control:
  - .1 The exhaust fans shall have VFD supplied and installed by Division 25 for control of the fan speed.
- .3 Fan Status:
  - .1 The controller shall monitor the fan status.
  - .2 Alarms shall be provided as follows:
    - .1 Fan Failure: Commanded on, but the status is off.
    - .2 Fan in Hand: Commanded off, but the status is on.
    - .3 VFD Fault.
    - .4 Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

1.6 MISCELLANEOUS CONTROLS

.1 Infloor Heat Temperature Control:

.1 Upon confirmation that the pump is running (P-3, P-4), the three way mixing valve shall modulate to maintain a heating fluid supply temperature between 24 °C and 44 °C based on a linear relationship with outdoor air temperature OAT of 10 °C and -10 °C. Provide current sensing relays for pump status. System shall monitor four (4) imbedded slab temperature sensors. System shall monitor return water temperature. System shall monitor mixing valve position feedback.

.2 Heat Trace Controller:

.1 Provide for monitoring of two (2) heat trace controller devices provided by Division 26. Each controller device has two points for monitoring. Provide Alarm back to operator for each point on each controller.

.1 Failure

.2 Ground Fault.

1.7 SMOKE MODE CONTROL

.1 Operator can place this AHU in SMOKE MODE (SM) to prevent smoke infiltration to the zone supplied by this AHU. Mode overrides all safety interlocks as well as startup sequences.

.1 Outdoor Air damper and Exhaust Air damper open fully. Return Air damper closes fully.

.2 Existing solenoid valve is energized, closing Smoke Damper in return air duct servicing selected zone.

1.8 FIRE MODE CONTROL

.1 Operator can place this AHU in FIRE MODE to exhaust smoke in the zone supplied by this AHU. Mode overrides all safety interlocks as well as startup sequences and overrides SMOKE MODE.

.1 Outdoor Air damper and Exhaust Air damper open fully. Return Air damper closes fully.

.2 Existing solenoid valve in panel is energized closing smoke damper in supply duct.

.3 System shall be set up with a toggle in the graphical user interface for the following zones in graphics:

.1 AHU-12

.1 Stores.

.2 Mental Health.

END OF SECTION

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1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA C22.1-21, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
- .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3 CSA Z462-12, Workplace Electrical Safety.
- .4 CSA Z32:19 Electrical safety and essential electrical systems in health care facilities.

.2 Institute of Electrical and Electronics Engineers (IEEE) / National Electrical Safety Code Product Line (NESC).
- .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standard Terms, 7th Edition.

1.2 DEFINITIONS

.1 Electrical terms used in electrical specifications and on electrical drawings are those defined by IEEE SP1122.

1.3 CARE, OPERATION AND START-UP

.1 Instruct Consultant and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Operating instructions to include following:
- .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- .2 Start up, proper adjustment, operating, maintenance, and shutdown procedures.
- .3 Safety precautions.
- .4 Procedures to be followed in event of equipment or component failure.
- .5 Other items of instruction as recommended by manufacturer of the system or equipment.

.3 Print operating instructions in laminated plastic adjacent to equipment or systems interface.

.4 Arrange and pay for manufacturer's factory service technician to supervise start-up, installation, check, adjust, balance and calibrate components and instruct operating personnel.

.5 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235-83(R2000).

.2 Motors, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SITE VISIT

.1 Prior to tender submission visit the site and become familiar with the job and all conditions which may affect the overall cost. Ignorance of existing conditions will not be considered as basis for extra claims. Refer to Division 01 - General Requirements for additional information.

1.6 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
- .1 Submit shop drawings for all electrical equipment unless otherwise indicated.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories and other items that must be shown to ensure coordinated installation.
.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
.4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
.5 If changes are required, resubmit corrected shop drawings.

.2 Manufacturer's Field Reports: submit to Consultant within 7 days of review, verifying compliance of work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
.3 Submit WHMIS MSDS information in accordance with Division 01 - General Requirements.
.4 Upon completion of work submit As-Built Drawings, Maintenance Manuals, and Submittals in accordance with Division 01 - General Requirements.

1.7 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 - General Requirements.
.2 All electrical work is to be carried out by qualified, licensed electricians or apprentices for the province of Prince Edward Island and the electrical contractor must have a valid contractor license issued by the province of Prince Edward Island.
.1 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
.3 The Consultant reserves the right to approve the quality of material and workmanship, and to call for any tests which they deem necessary to establish the integrity of the installation during the progress of the work and a complete test of each system at the completion of the work. The cost of such tests are not to be considered as extras.
.4 Health and Safety: in accordance with Division 01 - General Requirements.
.1 Protect exposed live equipment during construction for personnel safety.
.2 Shield and mark all live parts “LIVE 120 VOLTS”, or with appropriate voltage in English.
.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of an electrician.
.5 Quality Control: in accordance with Division 01 - General Requirements.
.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to the authority having jurisdiction for approval before delivery to site.
.2 Submit test results of installed electrical systems and instrumentation.
.3 Upon completion of work, submit load balance report as described in PART 3 - LOAD BALANCE.
.4 Submit certificate of acceptance from authority having jurisdiction upon completion of work to Consultant.
.6 Electrical systems within patient care areas as indicated on the Drawings are to be installed, tested and test reports provided to CSA Z32:19 requirements.
.7 Commissioning to be accomplished in accordance with approved commissioning plan as indicated in Division 01 - General Requirements.

1.8 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
.2 Pay all associated fees.
.3 Notify Consultant of changes required by Electrical Inspection Division prior to making changes.

.4 Submit Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of work to Consultant.

1.9 CO-ORDINATION

.1 Co-ordinate all work with work of other divisions to avoid conflict and notify Consultant if any changes are required.

.2 Locate electrical systems, equipment, and materials to provide minimum interference and maximum usable space.

.3 Where interference occurs, the Consultant must approve relocation of equipment and materials regardless of installation order.

.4 Notwithstanding the review of shop drawings, the Electrical Contractor may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination of the Electrical Contractor with other trades. The cost of this relocation will be the responsibility of the Electrical Contractor and the Consultant will determine the extent of relocation required.

.5 Leave space clear, and install equipment to accommodate future materials and/or equipment as indicated or specified, or to accommodate equipment and/or materials supplied by other Contractors.

.6 Verify that the spaces in which the equipment is to be installed is sufficient and install all equipment to maintain head room and clearances, to conserve space, comply with codes, and to ensure adequate space for future servicing.

.7 The Drawings for the Electrical work are diagrammatic performance Drawings only and are intended to convey the scope of work and indicate the general arrangement, locations, and size of equipment fixtures and outlets. The Drawings do not show Architectural, Mechanical or Structural details.

.8 Do not scale or measure Drawings, but obtain information regarding accurate dimensions, from the dimensions shown on the Architectural Drawings or by site measurements. Follow the Electrical Drawings for laying out the work only.

1.10 CUTTING AND PATCHING

.1 Electrical Contractor to inform all other divisions in time, of required electrical openings and/or penetrations. Where this requirement is not met, the cost of all cutting and associated work to provide openings and/or penetrations will be the responsibility of the Electrical Contractor. Obtain written approval of Structural Engineer before drilling through any beams or floors. Keep hole sizes to a minimum and be responsible to repair damage caused by lack of coordination.

1.11 DELIVERY, STORAGE AND HANDLING

.1 Provide Consultant with material delivery schedule within two weeks after award of Contract.

.2 Arrange for delivery access and unloading and/or storage areas with General Contractor.

1.12 INSPECTION OF WORK

.1 Periodic visits to the site during construction phase will take place to ascertain reasonable conformity to plans and specifications. The Contractor will be responsible for the execution of their work in conformity with the construction documents, the Contract, and the requirements of the inspection authority.

1.13 SCHEDULING OF WORK

.1 Work is to be scheduled as described in Division 01 - General Requirements.

.2 Become familiar with the scheduling requirements for the work and comply with these conditions.

.3 No additional monies will be paid for Contractor's requirement to comply with work scheduling conditions.

.4 Note that the Hospital intends to carry on business as usual throughout the facility and work activities must be coordinated to maintain electrical services and systems in occupied areas. Provide any required temporary work.

.5 Work activities which disrupt occupants of the building, such as excessive noise caused by drilling of walls, floors or ceilings must be approved and scheduled in writing by the Owner's Representative at least seven (7) days in advance.

.6 All power shutdowns or other work activities which may temporarily disrupt life safety systems or building operations must have prior approval of Owner and must be scheduled in writing at least fouteen (14) days in advance with the Owner's Representative.

.7 Overtime work, and work outside normal work hours deemed necessary to meet the schedule are the responsibility of the Contractor and must meet the requirements of the PEI Employment Standards Act. All costs resulting from such overtime work must be included in the Contractor's total tender price.

.8 Work in occupied areas of the existing Hospital to be coordinated with the Owner's Representative and Infection Control measures implemented as defined in Division 01 - General Requirements.

1.14 FIRE RATING OF PENETRATIONS

.1 Provide fire stopping and smoke seal materials at openings around cabling conduits passing through floors, ceilings and fire rated walls, as required to maintain fire rating equal to the fire rated assembly.

.2 Use ULC or approved equal fire barrier products installed in accordance with manufacturers instructions at each penetration.

1.15 NOISE CONTROL

.1 Cables or conduits penetrating through or entering into acoustical wall types must be appropriately sleeved and sealed to mitigate the transmission of structure and air borne sound. Reference the attached acoustic isolating details at the end of this section for more information.

.2 Conduit entering the top or bottom of gypsum board acoustic walls to be isolated as follows:

.1 Direct Route: Extend rigid conduit out of slab directly into the wall for a distance of approximately 75mm. Connect flexible conduit and maintain flexible conduit for the rest of the run. Rigid conduit must not touch any part of the wall, including the steel track. Oversize cut out of the track by at least 16mm.

.2 Indirect Route: Extend rigid conduit out of slab at a horizontal distance of approximately 75mm from the wall. Continue rigid conduit for a vertical distance of approximately 75mm. Connect flexible conduit and enter wall. Maintain flexible conduit inside the wall for distance of approximately 75mm at which point either rigid or flexible conduit can be used.

.3 Conduit entering the top of masonry acoustic walls to be isolated as follows:

.1 Extend rigid conduit out of slab at a horizontal distance of approximately 75mm. Continue rigid conduit for a vertical distance of approximately 75mm. Connect flexible conduit and enter block wall. Maintain flexible conduit inside the block wall for distance of approximately 75mm at which point either rigid or flexible conduit can be used.

.4 Where a penetration through a wall or floor requires both a fire and acoustic seal, both requirements shall be satisfied. A fire seal does not negate the need for an acoustic seal. Alterations to acoustic details dictated by fire code interpretations shall be reviewed by the Acoustical Consultant prior to installation.

.5 Acoustic sealant to be a non-hardening airtight caulking material in accordance with CAN/CGSB-19.21-M87.

.1 Acceptable material: Tremco or CGC Acoustic Sealant.

.2 If a fire and acoustic seal is required at the penetration use TREMstop Acrylic Firestopping Sealant. Submit shop drawings for fire and acoustic sealants in accordance with Division 01 - General Requirements.

.6 Electrical back boxes installed on one side of an acoustic wall must not come in contact with the other side of the wall, directly opposite. If the gap between back box and the opposite wall is less than 16mm it will need to be filled with loosely packed glass fibre insulation.

.7 Electrical boxes recessed into masonry or concrete components of an acoustic wall to leave a minimum 100 8mm of masonry or concrete. Full depth openings in masonry or concrete walls for electrical boxes are not acceptable.

.8 Acceptable material for fire barrier products to be 3M #CP25 fire barrier caulk, #303 putty, #FS 195 wrap and #CS195 sheet.

2 Products

2.1 PRIOR APPROVAL OF PRODUCTS

.1 The use of any product not listed by name in the specification must be approved by Consultant prior to tender submission.

.2 By using pre-approved product substitutions the Contractor accepts the responsibility and associated costs for all required modifications to circuitry, devices and wiring. The Contractor is to submit shop drawings with deviation from the original design highlighted to the Consultant for review and approval prior to rough-in.

2.2 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Division 01 - General Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Division prior to delivery and submit such approval as described in Part 1 - Submittals.

2.3 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor electrical equipment enclosures light grey to EEMAC 2Y-1.

2.4 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department.

.2 Porcelain enamel or acrylic decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 All junction and pull boxes are to be marked with an indelible ink marker to designate the circuit number of enclosed wiring, the designated panel name and electrical characteristics. Where boxes are painted in exposed areas, information is to be written on inside of box cover.

.2 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: Lamicoid 3 mm thick plastic engraving sheet, black white face, black white core, mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES:			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Labels:
.1 Embsossed plastic labels with 6 mm high letters unless specified otherwise.
.4 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
.5 Allow for average of twenty-five (25) letters per nameplate and label.
.6 Identification to be English.
.7 Nameplates for pull boxes and junction boxes to indicate system name and voltage characteristics.
.8 Nameplates for disconnects, starters and contactors to indicate equipment being controlled, wire, voltage, phase, number of power source and branch circuit breaker number.
.9 Nameplates for pull boxes and panelboards to indicate system name, overcurrent protection device rating, voltage, phase, and number of wire, and power source.
.10 Lamicoid nameplate installed on panelboards and splitter troughs shall indicate the following:
.1 Designated name of equipment.
.2 Voltage, number of phases and wires.
.3 Designation of power source.
.4 The following is an example:

PANEL 'MH1' 120/208V - 3PH - 4W
FED FROM DISTRIBUTION BOARD 'DP-1M2'

.11 Lamicoid nameplates installed on manual starters, control panels, contactors, disconnect switches, and large junction and pull boxes shall contain the following information:
.1 Designated name of equipment.
.2 Designated name of power source.
.3 Voltage, number of phases and wires.
.4 Branch circuit breaker number(s) where possible.
.5 The following is an example:

HEAT TRACE CONTROLLER
120V-1PH, FED FROM 'MHE1-51, 53'

.12 Install an additional nameplate on all, or any piece of electrical equipment, or apparatus, i.e. Main Switchboard, panelboards and fusible switches, etc., that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate an interrupting capacity sized "larger" than 10 KAIC. Example:

Minimum interrupting capacity of breakers installed in this panel is to be not less than 22 KAIC	Minimum interrupting capacity of fuses installed in this switch are to be not less than 100 KAIC

2.7 WIRING IDENTIFICATION

.1 Identify wiring with indelible pre-printed self-adhesive vinyl tape, indicating panel and circuit number. Wiring to be identified at both ends and at junction, pull boxes and splices.
.2 Maintain phase sequence and colour coding throughout.
.3 Colour code: to CSA C22.1-21, Canadian Electrical Code.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.
.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour (to match existing).

SYSTEM	PRIME COLOR	AUXILIARY COLOR
600V (non-essential)	Yellow	Green
208/120V (non-essential)	Yellow	--------
208/120V (essential)	Yellow	Red
Telephone	White	--------
Data	Green	--------
Fire Alarm	Red	--------
Public Address	Blue	--------
Nurse Call	Black	--------
Access Control	Brown	--------
Low Voltage Lighting	Black	--------
WAP	Yellow	--------
CCTV	Purple	--------

3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.2 LOCATION OF EQUIPMENT

.1 Change location of equipment at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

3.3 CONDUIT AND CABLE INSTALLATION

.1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
.3 Prior to rough-in, coordinate locations of conduit runs with other trades.

3.4 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless indicated otherwise.
.2 If mounting height of equipment is not specified or indicated, verify with Consultant before proceeding with installation.
.3 Install electrical equipment at the following heights:
  .1 Local switches: 1150 mm.
  .2 Wall receptacles:
    .1 General: 450 mm.

.2 Above top of counters or counter splash backs: 175 mm.
.3 Panelboards: 1600 mm or as required by Code.
.4 Telephone and data outlets: 450 mm.
.5 Fire alarm manual stations: 1050 mm.
.6 Fire alarm visual and/or audible signal devices: 2400 mm.
.7 Fire alarm end-of-line resistors: 1800 mm.
.8 Nurse Call - Staff Stations, Duty Stations: 1200 mm.
.9 Nurse Pull Cord Stations: 1050 mm.
.10 Wall mounted exit lights: 2400 mm.
.11 Access control readers and stations: 1200 mm.
.12 Door Operator Push Buttons: 1050 mm.
.13 Luminaires: as indicated in the Luminaire Schedule.
.14 Intercoms: 1500mm.
.15 CATV Outlets: as indicated on the Drawings.
.16 CCTV Cameras: as indicated on the Drawings.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.6 FIELD QUALITY CONTROL

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program will be permitted, under the direct supervision of a qualified licensed electrician.
.1 Permitted activities are to be determined based on the level of training attained and the demonstration of ability to perform specific duties.
.2 The work of this division to be carried out by a contractor who holds a valid Code 1 Electrical Contractor License as issued by the Province.
.3 Load Balance:
.1 Measure phase current to all new and modified panelboard and motor control centers with normal loads (lighting, computers, monitors, etc.) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
.2 Submit, at completion of work, report listing phase and neutral currents on new and modified panelboards and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
.4 Conduct and pay for following tests in accordance with Division 01 - General Requirements & CSA Z32-19.
.1 Power and distribution system including phasing, voltage, grounding and load balancing including testing of electrical systems in accordance with CSA Z32-19, Section 5.2.
.2 Circuits originating from branch distribution panels.
.3 Lighting and its control.
.4 Motors and associated control equipment including sequenced operations of systems where applicable.
.5 Systems:
.1 Fire Alarm
.2 Communications
.3 Nurse Call
.4 Public Address
.5 Access Control
.6 CCTV
.7 Telephone Pages Systems

.8 IR Traffic Beam
.9 Monitored Heat Trace System
.10 Vehicle Detection
.11 After Hours Entry Panel

.5 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.6 Insulation resistance testing for:
.1 Megger and record circuits, incoming service feeders and wiring to distribution panels up to 350 V with a 500 V instrument.
.2 Megger and record 350 – 600 V circuits, feeders and equipment with a 1000 V instrument.

.7 Provide instruments, meters, equipment and personnel required to conduct tests during and conclusion of project.

.8 Electrical systems located in Patient Care Areas indicated on the Drawings are to be tested in accordance with CSA Z32-19 and test results provided.

3.7 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.3 Clean luminaire lenses, housings, louvers, etc. upon completion of construction.

END OF SECTION

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1 General

1.1 DESCRIPTION OF WORK

.1 Work of this Section consists of the complete removal of all obsolete or abandoned electrical equipment with the limits of the Contract as indicated on the Drawings, including, but not limited to:
  .1 Existing obsolete lighting, wiring devices, conduit and wire, and raceway.
  .2 Existing obsolete power, communication and system conduit and wire/cabling.

.2 Alterations required to existing electrical or systems as required to facilitate installation of new equipment, ducting or to accomodate renovations.

.3 All removal or alteration work of electrical construction to be done in accordance with the safety standards outlined in the CSA 22.1-21.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

1.4 SITE SURVEY

.1 Prior to Tender submission, visit the site and survey and quantify the extent of the removals/alterations required for this contract and include for all costs in the total tendered price. Any existing conditions information indicated on the drawings is for general guidance only.

.2 In conjunction with site visit, review all drawings and include all costs due to existing conditions in total tendered price.

1.5 PROTECTION

.1 The Contractor is responsible for any damages to existing structures or systems as a result of the work.

.2 Contractor to provide for electrical connection of infection control pressurization fans in accordance with Division 01 - General Requirements.

1.6 SALVAGE MATERIAL

.1 Existing equipment and devices designated for reuse are to be removed, stored, cleaned and re-installed as indicated on the drawings.

.2 Identify any damaged equipment or materials intended for reuse prior to demolition and point out deficiencies to the Consultant and Owner's Representative at that time.

2 Products

2.1 NOT APPLICABLE

.1 Not Applicable.

3 Execution

3.1 GENERAL REMOVALS

.1 Where indicated remove all obsolete or abandoned equipment or electrical services including wire and conduit back to the source.

.2 Coordinate work of this Section with other Trades and Owner's Representative.

.3 Schedule all removal work with the Owner. Do not disrupt building operations except as permitted by the Schedule.

.4 Any existing conduit, wiring, boxes or equipment that is to remain in service is to be properly supported as required by the Canadian Electrical Code and colour coded in accordance with specification Section 26 05 00 - Common Work Results - Electrical. Any additional hangers, straps or fasteners required are to be supplied under this contract.

.5 Make alterations to existing electrical services as required and make good all circuits affected by the renovations.

.6 Any existing electrical circuits and/or equipment that are interrupted during construction to accommodate alterations but are to remain in service are to be reconnected and circuits made good.

.7 Any relocating of existing equipment and any rerouting of existing wire and conduit to coordinate with new work to be included in total tendered price.

3.2 IDENTIFICATION OF EXISTING CIRCUITS AND EQUIPMENT

.1 All circuits in existing panelboards serving renovated areas are to be traced out to identify any devices not labeled on existing directories and to confirm all circuits indicated on directories are accurate. Provide new, updated, typewritten circuit directories in all panelboards modified by the renovations.

.2 Provide identification indicating circuit and panel number at all new and existing wiring devices in renovated area.

.3 Provide equipment nameplates and labels for all new and existing equipment in renovated area.

.4 Equipment identification, wiring identification and conduit and cable identification is to be in accordance with Section 26 05 00 - Common Work Results - Electrical.

3.3 CUTTING

.1 Cutting required for removals and alterations to be to the approval of the Consultant and performed with appropriate power tools.

3.4 CLEANING

.1 Reused existing equipment to be cleaned in accordance with Division 01 - General Requirements.

END OF SECTION

1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CAN/CSA-C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .2 CSA C22.2 No.65-93 (R2008), Wire Connectors.

2 Products

2.1 MATERIALS

.1 Crimp style wire connectors, nylon insulated, with current carrying parts of copper alloy for conductors #16 AWG and smaller.

.2 Fork tongue or ring style connectors, nylon insulated crimp style. Terminals for connecting conductors #16 AWG and smaller to screw down terminals.

.3 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required. Use twist-on connectors for #14 AWG to #8 AWG conductors.

.4 Fixture type twist-on splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors #10 AWG or less.

.5 Compression type connectors for connecting #6 AWG conductors and larger, unless indicated otherwise.

.6 Clamps or connectors for armoured cable, aluminum sheathed cable, Teck cable and flexible conduit, as required to: CAN/CSA-C22.2 No.18.

.7 Splicing of access control cables where required to completed with DIN rail mounted terminal blocks in juction boxes, which are readily accessible within the ceiling space. Marrettes will not be accepted.

3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:
- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation is to meet secureness tests in accordance with CSA C22.2 No.65.
- .2 Install fixture type connectors and tighten. Replace insulating cap.
- .3 Where ACM conductors are used, apply zinc joint compound on aluminum conductors prior to installation of connectors or termination.
- .4 Install crimp style connectors with snap-on nylon caps on splices and joints on branch circuits.

.2 All connections are to be made electrically and mechanically secure. Size and type of connector to be in accordance with manufacturers recommendations for each wire size and combination of wires.

3.2 RESTRICTIONS

.1 Circuit splices are NOT permitted in equipment enclosures or electrical panelboards.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.
.2 Section 26 05 20 - Wire and Box Connectors (0-1000V).
.3 Section 26 05 29 - Hangers and Supports for Electrical Systems.
.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
.5 Section 26 50 00 - Lighting.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.2 No. 03-96, Test Methods for Electrical Wires and Cables.
  .2 CAN/CSA C22.2 No. 131, Type TECK 90 Cable.

2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for #8 AWG and larger, solid for #10 AWG and smaller.
.2 Minimum size to be #12 AWG for lighting and power, #14 AWG for controls, #16 AWG for low voltage and lighting controls.
.3 Conductors to be sized as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
.4 Single conductor metal sheathed cables are not permitted.
.5 Conductor sizes on drawings are based on copper conductors.
  .1 Aluminum Composite Material (ACM) conductors will be permitted as an acceptable alternative to copper conductors for panel feeders in excess of 60 A. ACM conductors are not to be terminated with copper bodied connectors, and all ACM conductor ends are to be treated with an oxide retardant coating prior to termination. The use of ACM conductors must be approved by the Consultant prior to tender submission.

2.2 TECK CABLE

.1 Cable: to CAN/CSA C22.2 No. 131.
.2 Conductors:
  .1 Grounding conductor: copper.
  .2 Circuit conductors: copper size as indicated.
.3 Insulation:
  .1 Chemically cross-linked polyethylene (XLPE), rated RW90, 600 V.
.4 Inner jacket: polyvinyl chloride material.
.5 Armour: interlocking aluminum.
.6 Overall covering: thermoplastic polyvinyl chloride material.
.7 Fastenings:
  .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  .2 Channel type supports for two or more cables at 1500 mm centers.
  .3 Threaded rods: 6 mm dia. to support suspended channels.
.8 Connectors:
  .1 Watertight spin-on style connectors or type approved for TECK cable.
    .1 Acceptable material:
      .1 Thomas & Betts - Star Teck.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.
.2 Type: AC90.
.3 Armour: interlocking type fabricated from aluminum strip.
.4 Connectors: standard as required, complete with double split rings in accordance with Section 26 05 20 - Wire and Box Connectors (0 - 1000 V).

2.4 CONTROL CABLES

.1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
.2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40°C polyethylene insulation with shielding of tape coated with paramagnetic material wire braid over each conductor and overall covering of PVC jacket.

3 Execution

3.1 WIRING METHODS

.1 All work to be concealed in finished areas.
.2 All work in or through fire rated structures or full height walls to be fire and / or acoustically sealed, in accordance with Section 26 05 00 - Common Work Results - Electrical.
.3 Panelboard feeders: building wire in conduit.
.4 Branch circuit work:
  .1 Concealed work in walls: building wire in conduit or armoured cable.
  .2 Horizontal work above accessible ceilings: building wire in conduit.
  .3 Surface work in unfinished areas: building wire in conduit.
  .4 Armoured cable may be used where permitted by the CSA 22.1-21 for drops to new equipment in existing gypsum board walls and ceilings.
.5 Drops to light fixtures to be building wire in flexible conduit or armoured cable, maximum length 1.5 m.
.6 Branch circuit wiring to be sized for a maximum voltage drop of 3% with a maximum voltage drop no greater than 5% to CSA 22.1-21.
  .1 15A branch circuits to be wired with:
    .1 #12 AWG up to 24m.
    .2 #10 AWG up to 38m.
    .3 #8 AWG up to 61m.
  .2 20A branch circuits to be wired with:
    .1 #12 AWG up to 18m.
    .2 #10 AWG up to 29m.
    .3 #8 AWG up to 45m.

3.2 GENERAL CABLE INSTALLATION

.1 Support cables in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1000 V).
.3 Cable Colour Coding: to Section 26 05 00 - Common Work Results - Electrical.
.4 Conductor length for parallel feeders to be identical.
.5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
.6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:
- .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 In surface and lighting fixture raceways in accordance with Section 26 50 00 - Lighting.

3.4 INSTALLATION OF TECK CABLE 0 - 1000 V

.1 Install Teck cables where indicated.
- .1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0 - 1000 V).

3.5 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.
.2 Use permitted only for concealed work in walls and vertical power supply drops to lighting fixtures.
.3 Install anti-shorts as required.
.4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0 - 1000 V).

3.6 INSTALLATION OF CONTROL CABLES

.1 Controls wiring for mechanical systems to be completed by the Controls Contractor. All other controls wiring to be completed by the Electrical Contractor.
.2 Install control cables in conduit as indicated.
.3 Ground control cable shield.
.4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0 - 1000 V).

3.7 RESTRICTIONS

.1 Splices in wire and cable #6 AWG and larger are not permitted.
.2 Flexible conduit or armoured cable drops to luminaires are to be installed from junction box to luminaires, loops between luminaires is not permitted.
.3 Wiring and cabling, both concealed and exposed, is to be installed parallel and/or perpendicular to building lines in a clean, organized and professional fashion. Where possible, wiring and cabling is to follow a common pathway.

3.8 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
.2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
.3 Perform tests before energizing electrical system.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CAN/CSA Z32-19, Electrical Safety and Essential Electrical Systems in Health Care Facilities, where applicable.

2 Products

2.1 EQUIPMENT

.1 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
.2 Insulated grounding conductors: green, type RW90, copper, size as indicated.
.3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  .1 Grounding and bonding bushings.
  .2 Protective type clamps.
  .3 Bolted type conductor connectors, as required by local authority having jurisdiction.
  .4 Bonding jumpers, straps.
  .5 Pressure wire connectors.

3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, and accessories.
.2 Install connectors in accordance with manufacturer's instructions.
.3 Protect exposed grounding conductors from mechanical injury.
.4 Use mechanical connectors for grounding connections to equipment provided with lugs.
.5 Soldered joints not permitted.
.6 Install a bonding wire in all conduits. Where EMT is used, run insulated copper ground wire in conduit.
.7 Install internal bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.
.8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: frames of motors, motor control centres, starters, control panels, and distribution panels.

3.3 HOSPITALS

.1 Grounding in Health Care Facilities to be completed and tested in accordance with to CAN/CSA Z32-19.

3.4 COMMUNICATION SYSTEMS

.1 Install grounding connections for public address, fire alarm, nurse call and access control systems as follows:

.1 Communications: make grounding system in accordance with ITSS Departmental requirements and as indicated in Section 27 05 26 - Grounding and Bonding for Communications Systems.
.2 Public address, nurse call, access control and fire alarm systems as indicated and in accordance with the manufacturers grounding instructions.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.
.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
.3 Perform tests before energizing electrical system.
.4 Disconnect ground fault indicator during tests.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.2 No. 18.4-04 (R2009), Hardware for the support of Conduit, Tubing, and Cable (Bi-National Standard with UL 2239).

2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended from walls and ceilings as required.

2.2 SPECIFIC PURPOSE SUPPORTS

.1 Specific purpose heat treated, spring steel fasteners to support boxes, conduit and cable from main structure, channels, and metal studs.

3 Execution

3.1 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
.2 Secure equipment to poured concrete with expandable inserts.
.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
.4 Secure surface mounted equipment with bar type box hangers. Ensure that box hangers are adequately supported to carry weight of equipment specified before installation.
.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
.6 Fasten exposed conduit or cables to building construction or support system using straps.
  .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  .3 Beam clamps to secure conduit to exposed steel work.
  .4 Strap AC90 at box location and at every 900 mm.
.7 Suspended support systems.
  .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
.8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
  .1 Additional supports are to be provided and installed in accordance with the Manufacturer's requirements for vandal resistant or ruggedized equipment.
.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
.11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
.12 Electrical boxes concealed in hollow gypsum board walls to be supported by specific purpose brackets or clips designed for stud wall construction.

.13 Electrical boxes recessed in gypsum walls for Behavioural Health rated devices are to be secured between studs, using screw gun mounting brackets. Reference Drawings for location of Behavioural Health rated devices.

3.2 RESTRICTIONS

.1 Do not use wire lashing, wood blocking, nylon or plastic strap ('Ty-Wraps') to support or secure raceways or cables.

.2 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.3 Do not surface mount equipement directly to the underside of steel Q-deck. A minimum separation of 33mm is required from the underside of Q-deck to Electrical infrastructure.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.1-21, Canadian Electrical Code, Part 1, 25th Edition.

2 Products

2.1 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.
.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
.3 Covers with turned edges for surface-mounted pull and junction boxes.
.4 Splicing of access control cables to be completed with DIN rail mounted terminal blocks in junction boxes. Marrettes will not be accepted.
  .1 Acceptable material:
    .1 Wiedmuller.
    .2 Allen Bradley.

3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

.1 Install pull boxes in inconspicuous, but accessible locations.
.2 Install terminal block as indicated in junction boxes for access control cable splices.
.3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
.2 Install size 2 identification labels indicating system name voltage and phase or box designation as indicated.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.
.2 Section 26 05 29 – Hangers and Supports for Electrical Systems.
.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware, a National Standard of Canada.
  .2 CSA 22.1-21, Canadian Electrical Code, Part 1, 25th Edition.

2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1-21.
.2 102 mm square or larger outlet boxes as required.
.3 Gang boxes where wiring devices are grouped.
.4 Blank cover plates for boxes without wiring devices.
.5 347 V outlet boxes for 347 V switching devices.
.6 Combination boxes with steel barriers where outlets for more than one system or voltage are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
  .1 Screw-on, turned edge covers for surface mounted boxes.
.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.
.4 102 mm square or octagonal outlet boxes for luminaires.

2.3 FIRE RATED POKE-THROUGHS

.1 150 mm diameter, round, flush mounted, fire-rated poke through with finishing rings to suit floor finish and black finish cover. Device mounting plate to accommodate two (2) duplex receptacles, one HDMI and four communications jacks. Poke-through to include junction box and low voltage dividers.
.2 Acceptable material:
  .1 Hubbell SystemOne #S1R6PTFIT; #S1R6CVRBLK; #S1R6SPH; #S1R6SPM

2.4 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.
.2 Knock-out fillers to prevent entry of debris.
.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
.4 Double locknuts and insulated bushings on sheet metal boxes.
.5 Double split rings for AC90 terminations.

3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush within finished walls using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers are not allowed.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes in accordance with Section 26 05 00 - Common Work Results - Electrical.

.7 Outlet boxes and conduit boxes to be flush mounted in new construction. Outlet and conduit boxes in existing construction to be flush mounted except in existing masonry filled block walls.

.8 Install vapour barrier boxes around all device boxes installed in acoustical wall types and structures. Fill void between device box and vapour barrier with isolating expansion foam where indicated.

.9 Install vapour barrier boxes around all galvanized steel device boxes recess mounted in exterior walls and structures.

END OF SECTION

1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .2 CSA C22.2 No. 83-M1985 (R2003), Electrical Metallic Tubing.
- .3 CSA C22.2 No. 211.2 (R2011), Rigid PVC (Unplasticized) Conduit.
- .4 CSA C22.2 No. 18.3-12, Conduit, Tubing, and Cable Fittings (Tri-National Standard with ANCE NMX-J-017 & UL 514B).
- .5 CSA 22.1-21, Canadian Electrical Code, Part 1, 25th Edition.

1.2 SUBMITTALS

.1 Provide shop drawings and product data in accordance with Division 01 - General Requirements.

1.3 LOCATION OF CONDUITS

.1 Drawings do not show all conduits. Those shown are in diagramatic form only.

2 Products

2.1 CONDUITS

.1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with steel set-screw couplings and connectors.
- .1 Exposed conduit installed in finished areas to be painted to match adjacent finished surfaces.

.2 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.3 Flexible metal conduit: to CSA C22.2 No. 56.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits spaced every 1.5 m on center.

.4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: To CAN/CSA C22.2 No. 18.3, manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits, unless indicated otherwise.

.3 Ensure conduit bends other than factory “ells” are made with an approved bender. Making offsets and other bends by cutting and rejoining 90 degree bends is not permitted.

.4 Connectors and couplings for EMT. Steel set-screw type, size as required.

2.4 FISH CORD

.1 Polypropylene.

3 Execution

3.1 INSTALLATION

.1 Install all conduit, conduit fittings and accessories in accordance with the latest edition of the CSA 22.1-21 in a manner that does not alter, change or violate any part of the installed system components or the certification of the components.
.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
.3 Conceal conduits except in mechanical, electrical, service rooms and in unfinished areas.
.4 Use rigid PVC conduit for outdoor installations or as indicated on the Drawings.
.5 Use flexible metal conduit for connection to motors in dry areas and connection to recessed luminaires without a prewired outlet box.
.6 Use AC-90 for vertical power supply drops to luminaires.
.7 Minimum conduit size for lighting and power circuits: 21 mm. 16 mm conduit is acceptable control cabling or for switch leg drops only where one two-wire circuit and ground is required. Minimum size for communications conduit to be 27mm.
.8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
.9 Field threads on conduit must be of sufficient length to draw conduits up tight.
.10 Install fish cord in empty conduits.
.11 Run 2 - 35 mm spare conduits up to ceiling space from each new recess mounted panelboard. Terminate these conduits in 152 x 152 x 102 mm junction boxes in accessible ceiling space.
.12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
.13 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.
.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
.3 Run conduits in flanged portion of structural steel.
.4 Group conduits wherever possible on suspended channels.
.5 Do not pass conduits through structural members except as indicated.
.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.
.2 Do not install horizontal runs in masonry walls.
.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials rubbish, tools and equipment.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.2 No.184.1, Solid-State Dimming Controls (Bi-national standard with UL 1472).

1.3 SUBMITTALS

.1 Provide shop drawings and product data in accordance with Division 01 - General Requirements.
  .1 Submit product data sheets for lighting dimming control equipment. Include product characteristics, performance criteria, physical size, limitations and finish.
.2 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

2 Products

2.1 0 - 10 VDC CONTROL DIMMERS

.1 Operating voltage dimming: Control 0 - 10 VDC, 120V, 8A rated line voltage switch.
.2 ON/OFF rocker style or push button switch.
.3 Manual pre-set slide control or push button for adjustment from maximum intensity to off, and minimum threshold adjustment to eliminate lamp flicker.
.4 Finish: White gloss.
.5 CUL Listed.
.6 Five-year warranty.
.7 Complete with matching stainless steel faceplate for single or ganged wall boxes.
.8 Suitable for installation in a one gang wall box.
  .1 Provide physical partition when ganged with one or more line voltage devices.
.9 Acceptable material:
  .1 Lutron #DVSTV-WH.
  .2 nLight #SPODMRD WH.
  .3 Wattstopper #RH4FBL3PW.
  .4 Leviton.

2.2 WIRELESS 0-10 VDC CONTROL DIMMER

.1 Operating voltage dimming: Control 0 - 10 VDC, 120V, 8A rated line voltage switch.
.2 ON/OFF rocker style or push button switch.
.3 Manual pre-set slide control or push button for adjustment from maximum intensity to off, and minimum threshold adjustment to eliminate lamp flicker.
.4 Finish: White gloss.
.5 CUL Listed.
.6 Five-year warranty.
.7 Complete with matching faceplate.
.8 Suitable for use without a wall box, device to be RI Wireless and mounted to glazing in Charting Rooms.
.9 Minimum five (5) year battery life.
.10 Acceptable material:
  .1 Lutron #PICO Series, complete with #PP-1204 (power pack).
  .2 nLight.

.3 Cooper.
.4 Leviton.

2.3 BEHAVIOURAL HEALTH 0-10 VDC CONTROL DIMMER

.1 Operating voltage dimming: Control 0 - 10 VDC, 120V, 8A rated line voltage switch.
.2 ON/OFF rocker style or push button switch.
.3 Manual pre-set slide control or push button for adjustment from maximum intensity to off, and minimum threshold adjustment to eliminate lamp flicker.
.4 Finish: White gloss.
.5 CUL Listed.
.6 Five-year warranty.
.7 Complete with impact resistant, washdown, anit-ligature and Behavioural Health rated faceplate. Torx screw fasteners and 'pick proof' faceplate gasket.
.8 Acceptable material:
.1 Kenall #MPWS-ARE.
.2 Legrand #WSP (alternate Behavioural Health rated device with wall plate.

3 Execution

3.1 INSTALLATION

.1 Install dimmers in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.
.2 Demonstrate that dimming systems are installed as indicated.
.3 Demonstrate that dimming systems operate as intended and that there are no problems in starting lamps, nor in keeping them lit and flicker-free at any setting of dimming intensity control.
.4 Demonstrate that no audio, radio or TV interference is carried by system.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.
.2 Section 26 50 00 - Lighting.

1.2 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

1.3 SYSTEM DESCRIPTION

.1 Occupancy sensors to turn lighting on when entering a controlled area, and off after the area is vacated.
.2 Products sourced from a single manufacturer.

2 Products

2.1 TECHNOLOGY

.1 Passive infrared (PIR) sensing systems are passive and react only to energy sources. They detect the difference between heat emitted by the human body and the background space.

2.2 PASSIVE INFRARED AUTOMATIC WALL SWITCH

.1 Advanced PIR technology wall switch to provide automatic control of lighting.
.2 Programmable for either Manual-ON or Automatic-ON.
.3 Digital time delay of 15 seconds to 30 minutes.
.4 LED to indicate occupancy detection.
.5 Adjustable unit sensitivity.
.6 No minimum load requirement.
.7 Compatible with all load types.
.8 Five-year warranty.
.9 Load: up to 800 W @ 120 V.
.10 Minimum coverage: 180 deg. - 290 sq.ft.
.11 Finish: White.
.12 Acceptable material:
    .1 Lutron #4-MS-OPS6M2-DV.
    .2 Cooper Greengate #OSW-P-0801-120-W.
    .3 Wattstopper #PW-100.
    .4 nLight.

2.3 DUAL TECHNOLOGY CEILING SENSOR

.1 40kHz frequency ultrasonic transmission and PIR sensor..
.2 Digital time delay of 15 seconds to 30 minutes (fixed), walk-through or test-mode.
.3 Sensitivity adjustment.
.4 20 sq.m. of walking motion mounted at 3m.
.5 Dimensions: 115mm diameter, 25m deep.
.6 Five year warranty.
.7 Acceptable material:
    .1 Lutron #LOS-CDT-2000.
    .2 Cooper Greengate #OAC-U-1000.
    .3 WattStopper #DT-305.
    .4 nLight.

2.4 POWER PACK WITH RELAY

.1 Power pack to provide 24 VDC operating voltage to occupancy sensors and control lighting loads with auxiliary relay or to control 120V lighting from existing 347 volt controlled lighting circuits.
.2 Auto-On or Manual-On selectable operating mode.
.3 Power: 347 V or 120 V, 24 VDC output.
.4 Relay load ratings: 15A load.
.5 Plenum rated.
.6 Five year warranty.
.7 Acceptable material:
  .1 Lutron #PP347-H.
  .2 Wattstopper #B34.7DP
  .3 Cooper Greengate #SPD15-347.
  .4 nLight.

3 Execution

3.1 INSTALLATION

.1 Obtain complete installation instructions from manufacturer prior to rough-in.
.2 Review sensor locations on site prior to rough-in and install in location within room that provides maximum sensor coverage but confines coverage to the room. Motion outside the room is not to activate lighting within the room.
.3 Locate occupancy sensors on vibration-free surfaces at least 1.8 m away from air vents.
.4 Wire sensors into circuits as indicated to control luminaires in the indicated areas of coverage.
.5 Program sensors and timers with time delay off set to 5 minutes.
.6 Occupancy sensors are to be individually adjusted in accordance with the manufacturer's recommendations for the specific room in which they are installed, taking into account room shape, size and usage.
.7 Test for acceptable operation.
.8 Demonstrate operation to the satisfaction of the Consultant.

3.2 COMMISSIONING

.1 The system must be completely commissioned prior to interim inspection to verify optimum operation.
.2 Sensors must be added or relocated and patterns adjusted as required to eliminate nuisance turning on/off of luminaires.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
  .1 CAN/CSA C22.2 No. 130, Requirements for Electrical Resistance Heating Cables and Heating Device Sets.

1.3 SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 General Requirements. Include product characteristics, performance criteria, and limitations.

.2 Record layout of cables complete with dimensioned information from structural gridlines to facilitate future access and coordination, indicating depth of and location of cables, as on As-Built drawings.

2 Products

2.1 MANUFACTURERS

.1 Acceptable material:
  .1 Britech #FT215-1410B (trace) and #GPT-180 (controller).
  .2 Pentair #B/62HE4280 / 455 / 3396 / 208 / 15 / H25A / Y / 112 , complete with #c910 and #RTD10CS.
  .3 Raychem
  .4 Caloritech

2.2 SELF REGULATING HEATING CABLE

.1 Heating cables: to CSA C22.2 No. 130.1, CSA C22.2 No. 130.3.

.2 Minimum startup temperature: -55°C, maximum operating temperature: 65°C. Five (5) year warranty.

.3 208V single-phse, 6W/ft, field but to length on site and complete with all cold leads, caps and splice kits for a fully operable system.

.4 Copper alloy conductor with polyolefin insulation, copper ground braid, PVC caps, protective jacket, factory spliced and sealed cold leads.

2.3 ACCESSORIES

.1 Strapping to hold cables permanently in place around mechanical lines.

2.4 CONTROLS

.1 Resistance temperature detector: three wire platinum RTD box armor wired with 20 foot cable for remote sensing, in cold floor space. Two (2) year warranty.

.2 Contactors: Integral double pole mechanical contactor rated for 30A at 208V.

.3 Controllers to be complete with CSA rated enclosure complete with wall mount flange, 200 x 150 x 150 mm, 30 mA ground fault protection, cover mounted display and controls and provision for remote monitoring relay.

.4 Adjustable ground fault detection threshold and automatic self test every 24 hours and every hour when load is turned on.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install heating cable in accordance with manufacturer's instructions.
.2 Secure cable to sanitary and rain water lines line indicated as on the Drawings. Strapping located no greater than 600mm apart.
.3 Coordinate installation of heat trace with Mechanical Contractor, General Contractor and Construction Schedule.
.4 Place remote temperature sensor as recommended by manufacturer.
.5 Field alter heating cable length as required to manufacturer's instructions.
.6 Ensure cables do not bunch or cross.
.7 Ground cable to building grounding system.
.8 Make power and control connections.

3.3 FIELD QUALITY CONTROL/COMMISSIONING

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
.2 Use 500 V megger to test cables for continuity and insulation value and record readings as follows:
    .1 On cable reel.
    .2 After installation of each mechanical lines.
    .3 48 hours after installation.
.3 Where resistance of 50 megohms or less is measured, stop work and advise Owner's Representative. Replace cable as required.
.4 Record exact routing of cabling, location of sensor(s), splices and controllers on As-Built Drawings, complete with dimensional information from structural gridlines to facilitate future access and coordination.
.5 Verify ground fault protection, supervisory signals, alarms and BMS interface functionality, provided through heat trace controller.
.6 Provide system training to Hospital Maintenance personnel, as per Division 01 - General Requirements.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.
.2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimensions.

2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  .1 Install circuit breakers in panelboards before shipment.
  .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
.2 250 V panelboards: bus and breakers rated for minimum 10 KAIC (symmetrical) minimum interrupting capacity respectively or as indicated on electrical drawings.
  .1 Where new circuit breakers are installed in existing panelboards, the minimum interupting capacity of the new circuit breakers is to match the minimum interupting capacity of the existing panelboard and associated circuit breakers.
.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
.5 Two keys for each panelboard and key panelboards alike.
.6 Tin plated aluminum bus with neutral of same ampere rating as mains. Panelboards are to be supplied fully bussed.
.7 Recess mounted trim and door finish: baked grey enamel with concealed front bolts and hinges.
.8 Minimum tub width of 500 mm.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
.3 Lock-on devices for breakers as indicated in panel schedules. Turn over unused lock-on devices to Departmental Representative.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.
.3 Nameplate for each circuit in existing distribution panelboards size 2 engraved as indicated.
.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 MANUFACTURERS

.1 Acceptable material:
  .1 Cutler-Hammer PLR 1a Series (to match existing).

3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
.2 Mount panelboards to height specified in Section 26 05 00 – Common Work Results - Electrical or as indicated.
.3 Install two (2) x 35mm spare conduit complete with pull cord, up to accessible ceiling space from each flush mounted panelboard. Terminate these conduit in a 152mm x 152mm x 102mm junction box, located in the accessible ceiling space above the panelboard.
.4 Connect loads to circuits.
.5 Connect neutral conductors to common neutral bus with respective neutral identified.
.6 Balance phase loading and complete testing in accordance wiht Specification Section 26 05 00 - Common Work Results - Electrical.

END OF SECTION

1 General

1.1 LIST OF ELECTRICAL PANEL SCHEDULES

.1 PANEL 'MH1'
.2 PANEL 'MH2' (NON-ESSENTIAL)
.3 PANEL 'MHE1' (ESSENTIAL)

PANEL 'MH1'

DESIGNATION	LOAD A	LOAD B	LOAD C	P	BKR	CIRCUIT			BKR	P	LOAD A	LOAD B	LOAD C	DESIGNATION
RECEPT: COORD. 5630	360			1	20	1	A	2	15	1	240			RECEPT: EXAM 5636 <A>
RECEPT: COORD. 5660		480		1	20	3	B	4	15	1		240		RECEPT: WC 5673, 5676
RECEPT: RECLINER 5632 & 5634			360	1	15	5	C	6	20	1			120	RECEPT: BUS. CENTRE 5671A
RECEPT: KITCHEN 5628A (MICRO)	1000			1	20	7	A	8	20	1	500			RECEPT: BUS. C. 5671A (PH.COPY
RECEPT: KITCHEN 5628A (FRIDGE)		750		1	15	9	B	10	15	1		360		RECEPT: BUS. CENTRE 5671A
RECEPT: KITCHEN 5628A (ICE)			750	1	15	11	C	12	15	1			360	RECEPT: MED ROOM 5674
RECEPT: KITCHEN 5628A (COFFEE	750			1	15	13	A	14	20	1	240			RECEPT: OBSERVATION 5672
SPARE				1	15	15	B	16	20	1		120		RECEPT: TEAMS ROOM 5677
RECEPT: FAMILY CONSULT 5615			480	1	15	17	C	18	15	1			240	RECEPT: TELEHEALTH 5639
RECEPT: KITCHEN 5628A	480			1	15	19	A	20	15	1	360			RECEPT: T. RM 5677 & CHART.5653
RECEPT:SH. STAY 5626, 5627 <A>		480		1	15	21	B	22	15	1		750		RECEPT: T. ROOM 5677 (FRIDGE)
RECEPT:SH. STAY 5621, 5623 <A>			240	1	15	23	C	24	20	1			1000	RECEPT: T. ROOM 5677 (MICRO)
RECEPT: WAIT 5611, SEC. 5602	360			1	15	25	A	26	20	1	1000			RECEPT: T. ROOM 5677 (COFFEE)
RECEPT: WC 5601		360		1	15	27	B	28	20	1		120		RECEPT: T. ROOM 5677 (COUNTER
RECEPT: ASSESS. 5668, 5669			480	1	15	29	C	30	15	1				SPARE
RECEPT: ASSESS. 5667, 5668	480			1	15	31	A	32	15	1				SPARE
SPARE				1	20	33	B	34	15	1				SPARE
SPARE				1	20	35	C	36	15	1				SPARE
SPARE				1	20	37	A	38	15	1				SPARE
SPARE				1	20	39	B	40	15	1				SPARE
SPACE						41	C	42	15	1				SPARE
SPACE						43	A	44	15	1				SPARE
SPACE						45	B	46						SPACE
SPACE						47	C	48						SPACE
SPACE						49	A	50						SPACE
SPACE						51	B	52						SPACE
RECEPT: KITCHEN 5628A (CNTER)			120	1	20	53	C	54						SPACE
PHASE LOADS:	3430	2070	2430								2340	1590	1720	
TOTAL PHASE LOADS	5770	3660	4150								SUPPLY: 120/208V,3ø,4w			
TOTAL LOADS	13580			<*> - INDICATES LOCKING BREAKER							MAINS: 200A RATED, 125 MB, 10 KAIC			
											NUMBER OF CIRCUITS: 54			
CURRENT AT 208V/3PH:	38			<A> - INDICATES AFCI TYPE BREAKER							MOUNTING: RECESSED			

PANEL 'MH2' (NON-ESSENTIAL)

DESIGNATION	LOAD A	LOAD B	LOAD C	P	BKR	CIRCUIT			BKR	P	LOAD A	LOAD B	LOAD C	DESIGNATION
RECEPT: H.KP 5645	360			1	20	1	A	2	20	1				SPARE
RECEPT: H.KP 5650		240		1	20	3	B	4	20	1				SPARE
RECEPT: SOILED 5646 & 5641A			480	1	15	5	C	6	20	1				SPARE
RECEPT: LAUNDRY 5641B (WASH)	1000			1	20	7	A	8	15	1				SPARE
RECEPT: LAUNDRY 5641B (DRY)		1500		2	30	9	B	10	15	1				SPARE
			1500			11	C	12	15	1				SPARE
RECEPT: CLEAN 5642	480			1	15	13	A	14	15	1				SPARE
RECEPT: PT BEL. 5641A		360		1	15	15	B	16	15	1				SPARE
RECEPT: OFF. 5651 & ASSESS 5652			480	1	15	17	C	18	15	1				SPARE
RECEPT: OFF. 5651 & ASSESS 5652	480			1	15	19	A	20	15	1				SPARE
RECEPT:ASSESS 5653 & 5662		600		1	15	21	B	22	15	1				SPARE
RECEPT: HSKP 5658			480	1	20	23	C	24	15	1				SPARE
RECEPT: STORAGE 5659	480			1	15	25	A	26	15	1				SPARE
RECEPT: STORAGE 5659		360		1	15	27	B	28						SPACE
RECEPT: ASSESS 5662 & 5663			600	1	15	29	C	30						SPACE
RECEPT: MEETING RM 5638	360			1	15	31	A	32						SPACE
RECEPT: MEETING RM 5638		240		1	15	33	B	34						SPACE
SPACE						35	C	36						SPACE
SPACE						37	A	38						SPACE
RECEPT: ROOFTOP		120		1	15	39	B	40						SPACE
HSKP 5658 CHEM SYSTEM <*>			120	1	20	41	C	42						SPACE
PHASE LOADS:	3160	3420	3660											
TOTAL PHASE LOADS	3160	3420	3660								SUPPLY: 120/208V,3ø,4w			
TOTAL LOADS	10240										MAINS: 200A RATED, 125A MB, 10 KAIC			
						<*> - INDICATES LOCKING BREAKER					NUMBER OF CIRCUITS: 42			
CURRENT AT 208V/3PH:	28										MOUNTING: RECESSED			

PANEL 'MHE1' (ESSENTIAL)

DESIGNATION	LOAD A	LOAD B	LOAD C	P	BKR	CIRCUIT			BKR	P	LOAD A	LOAD B	LOAD C	DESIGNATION
RECEPT: EXAM 5636 <A>	360			1	15	1	A	2	15	1	240			RECEPT: EXAM 5636 <A>
RECEPT: SHORT STAY 5621 <A>		240		1	15	3	B	4	15	1		480		RECEPT: SECURITY 5602
RECEPT: SHORT STAY 5623 <A>			240	1	15	5	C	6	15	1			360	RECEPT: OBSERVATION 5672
RECEPT: SHORT STAY 5626 <A>	240			1	15	7	A	8	15	1	240			RECEPT: OBSERVATION 5672
RECEPT: SHORT STAY 5627 <A>		240		1	15	9	B	10	15	1		120		RECEPT: MED RM 5674 (DISP) <*
RECEPT: WARD CLERK 5612			240	1	15	11	C	12	15	1			120	ECEPT: MED RM 5674 (FRIDGE) <*
RECEPT: CHARTING 5631	480			1	15	13	A	14	15	1	240			RECEPT: OFFICE 5639
RECEPT: CHARTING 5631		480		1	15	15	B	16	20	1				SPARE
RECEPT: CHARTING 5655			480	1	15	17	C	18	20	1				SPARE
RECEPT: CHARTING 5655	480			1	15	19	A	20	15	1				SPARE
RECEPT: CLEAN 5642 (B WARM)		1000		1	20	21	B	22	15	1				SPARE
SPACE						23	C	24	15	1				SPARE
SPACE						25	A	26	15	1	120			CNTRLS / HANDFREE <*>
SPACE						27	B	28	15	1		750		LIGHTING: UNDER CANOPY
SPACE						29	C	30	15	1			750	LIGHTING: UNDER CANOPY
SPACE						31	A	32	15	1	120			SPARE
SPACE						33	B	34	15	1		120		BMS <*>
NURSE CALL <*>			120	1	15	35	C	36	15	1			120	NO & CO DETECTION <*>
SPACE						37	A	38	15	1	750			AFTER HOURS ENTRY SYSTEM
SPACE						39	B	40	15	1		750		LIGHTING: MHA (CORRIDOR)
SPACE						41	C	42	15	1			750	LIGHTING: MHA (CORE)
SPACE						43	A	44	15	1	750			LIGHTING: MHA (WEST)
SPACE						45	B	46	15	1		120		LIGHTING: MHA (EAST)
HEAT TRACE CONTROLLER <*>			1250	2	30	47	C	48	15	1			120	FA ASPIRATING & FA BOOSTER <*>
	1250					49	A	50	15	1	600			FA ASPIRATING SUPERVISORY <*>
HEAT TRACE CONTROLLER <*>		1250		2	30	51	B	52	15	1		120		ACCESS CONTROL <*>
			1250			53	C	54	15	1			240	MECH. CONTROLS CCT <*>
PHASE LOADS:	2810	3210	3580								3060	2460	2460	EXIT SIGNS <*>
TOTAL PHASE LOADS	5870	5670	6040								SUPPLY: 120/208V,3ø,4w			
TOTAL LOADS	17580					<*> - INDICATES LOCKING BREAKER					MAINS: 200A RATED, 125A MB 10 KAIC			
											NUMBER OF CIRCUITS: 54			
CURRENT AT 208V/3PH:	49					<A> - INDICATES AFCI TYPE BREAKER					MOUNTING: RECESSED			

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).
- .4 CSA Z32-19, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

2 Products

2.1 SWITCHES

.1 15 A, 120V or 347V single pole, or three-way switches as indicated to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:
- .1 Terminal holes approved for # 10 AWG conductor.
- .2 Silver alloy contacts.
- .3 Urea or melamine molding for parts subject to carbon tracking.
- .4 Suitable for side wiring.
- .5 White toggle (Non-Essential Power) or Red toggle (Essential Power).

.3 Toggle operated fully rated for LED drivers/lamps and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Tamper resistant Torx screws in areas as indicated on the Drawings.

.6 Acceptable manufacturers or approved equal:
- .1 Leviton #1101-CW (120V) / #18201-CW/R (347V).
- .2 Hubbel #CS115W (120V) / #HBL1820W/R (347V).
- .3 Cooper #1201W (120V) / #AH18201W/R (347V).
- .4 Pass and Seymour #CS15AC1W (120V).

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type as indicated, U ground, to: CSA-C22.2 No.42 with following features:
- .1 White (Non-Essential Power) or Red (Essential Power) thermoplastic molded housing.
- .2 Suitable for # 10 AWG conductor for side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.
- .6 Hospital grade.
- .7 Complete with tamper resistant shroud.
- .8 Tamper resistant Torx screws in areas as indicated on the Drawings.

.9 Acceptable manufacturer or approved equal:
.1 Standard Hospital Grade Duplex, CSA type 5-15 R:
.1 Leviton #8200-HLR/W.
.2 Hubbell #HBL8200 W/R.
.3 Cooper #8200 W/R.
.4 Pass & Seymour #8200H W/R.
.2 Standard Hospital Grade Duplex; CSA 5-20R Type:
.1 Leviton #8300-HLR/W.
.2 Hubbell #HBL8300 W/R.
.3 Cooper #8300 R/W.
.4 Pass & Seymour #8300H W/R.

.2 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
.2 Cover plates from one manufacturer throughout project.
.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
.4 Coverplates for all wiring devices shall be 302 stainless steel complete with beveled edge, unless specifically indicated otherwise.
.1 Exposed devices which are located in Rooms where patients may be left unattended are to be rated for use in Behavioural Health applications. These rooms include: 5615, 5621, 5623, 5625 to 5628 (inclusive), 5632 to 5637 (inclusive), 5652, 5653, 5656, 5661 to 5664 (inclusive) 5667, 5668 and 5669.
.2 Prime grade 11-gauge steel, backplate, 14-gauge cover, countersunk holes for Torx security fasteners. White TGIC polyester powder coat finish.
.1 Acceptable Material: Legrad Mighty Mac #WSP / UUPP Series.
.5 Sheet metal cover plates with turned-in corners for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
.6 Identification:
.1 All receptacles throughout the renovated area are to each have individual size 1 lamicoid nameplate installed on wall directly above and abutting to top of its receptacle plate, with information as indicated in Section 26 05 00 - Common Work Results - Electrical.
.1 Each lamicoid plate to have designated panel numbers and/or letters, circuit no.(s) and any other information as may be deemed necessary. Each conductor within receptacle outlet box to have same panel and circuit numbers as identifying lamicoid plate, installed on wires as close as possible to where termination takes place on receptacle using self laminating labels. Lamicoid plates to be size 1, red face and white core for essential power systems, back face and white core for non-essential power systems.
.2 Receptacles denoted as housekeeping on the drawings are to each have a lamicoid nameplate installed on wall directly above receptacle faceplate, which reads "Housekeeping". Lamicoid nameplate to be size 1, with black face and white core.

3 Execution

3.1 INSTALLATION

.1 Switches:
.1 Install single throw switches with handle in "UP" position when switch closed.
.2 Install switches in gang type outlet box when more than one switch is required in one location.
.3 Mount switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Receptacles:
- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .3 Do not use back entrances for connecting wiring devices to circuits. Wrap conductors around screw terminals and tighten. Tighten all unused screw terminals.

.3 Cover plates:
- .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .4 Do not install outlet boxes back-to-back in wall; allow 150 mm horizontal clearance between boxes.

3.2 TESTING

.1 Wiring devices in Health Care Facilities which are within the Patient Care Areas as indicated on the Drawings, are to be tested in accordance with CSA Z32-19, Section 5.2.

.2 All receptables to be tested for voltage drop and results recorded where branch circuit voltage drop exceeds 3% for branch circuit panelboard to the point of utilization, in accordance with the Canadian Electrical code, the wire will have to be replaced to meet the 3% requirement.

.3 All hospital grade receptacle to be tested for pull out tension and results recorded. Any receptacle not meeting a 340 gram tension must be replaced with an acceptable device.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

2 Products

2.1 MOULDED BREAKERS GENERAL

.1 Moulded-case circuit breakers, to CSA C22.2 No. 5.
.2 Bolt-on moulded-case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg. C ambient.
.3 Common-trip breakers: with single handle for multi-pole applications.
.4 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection. Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
.5 Breakers are to be by the same manufacturer as the panelboard in which they are being installed.
.6 Circuit breakers to have minimum 10 kA symmetrical rms interrupting capacity rating to match panelboard with minimum 10 kA at 208 V and 22 kA at 600 V.
.7 Breakers must be new, complete with original factory warranty and supplied from an authorized manufacturer's distributor.

2.2 OPTIONAL FEATURES

.1 Lockout handles on all feeder breakers, and lockout hasps and fualt current protection on branch circuit breakers as indicated.

3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.
.2 Connect main secondary service to line terminals of breaker.
.3 Connect load terminals of breaker to feeders.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance Section 26 05 00 – Common Work Results - Electrical
.2 Check factory made connections for mechanical security and electrical continuity.
.3 Check trip unit settings and to ensure proper working operation and protection of components.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CAN/CSA C22.2 No. 4-89 (R2000), Enclosed Switches.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

2 Products

2.1 DISCONNECT SWITCHES

.1 Non-fusible, horsepower rated disconnect switch in CSA Enclosure type 1, to CAN/CSA C22.2 No. 4, size as indicated.
.2 Provision for padlocking in on-off switch position by three locks.
.3 Mechanically interlocked door to prevent opening when handle in ON position.
.4 Quick-make, quick-break action.
.5 ON-OFF switch position indication on switch enclosure cover.

2.2 MANUFACTURERS

.1 Acceptable material:
  .1 Cutler-Hammer.
  .2 Siemens.
  .3 Square D.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
.2 Indicate name of load controlled on size 4 nameplate.

3 Execution

3.1 INSTALLATION

.1 Install disconnect switches as indicated.
.2 In finished areas mount disconnect switches on top of flush mounted junction box with conduit nipple on its coverplate into the back of the switch.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)
  .1 IEC 947-4-1-1990, Part 4: Contactors and motor-starters.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
.2 Product data to indicate:
  .1 Mounting method and dimensions.
  .2 Starter size and type.
  .3 Layout of identified internal and front panel components.
  .4 Enclosure types.
  .5 Wiring diagram for each type of starter.
  .6 Interconnection diagrams.

2 Products

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR SWITCHES

.1 Manual switch, 1, 2 or 3 poles as required. Mounted in CSA 1 Enclosure with quick-make, quick-break toggle switch.
.2 Rated for 30 A at 250 V AC, 20 A at 600 V AC.
.3 Shielded toggle with provision to be padlocked in ON or OFF positions.
.4 Acceptable material:
  .1 Cutler-Hammer #B230AG/B330AG.
  .2 Square D Class #2510, Type K.
  .3 Hubbell No. #7832/7810-UD.
  .4 Siemens Class 12.

2.3 MANUAL MOTOR STARTERS

.1 Single, three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  .1 Switching mechanism, quick make and break.
  .2 One/three overload heaters, manual reset, trip indicating handle.
.2 Accessories:
  .1 Toggle heavy duty labelled as indicated.
  .2 Indicating light: standard heavy duty type and colour as indicated.
  .3 Locking tab to permit padlocking in "ON" or "OFF" position.
.3 Acceptable material:
  .1 Cutler-Hammer Type MS.
  .2 Siemens Type SMF.
  .3 Square D Class #2510, Type F.
  .4 Allen Bradley Bulletin #600.

2.4 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
- .1 Contactor solenoid operated, rapid action type, IEC AC4 rated, contactor size as follows:
  - .1 23 A for 0-10 hp.
  - .2 37 A for 15-20 hp.
  - .3 60 A for 25-30 hp.
- .2 Bimetal motor overload protective device providing three phase protection and electronic trip overloads for 5 HP motors or larger, with following features:
  - .1 Selectable overload settings.
  - .2 Phase loss protection.
  - .3 Phase unbalance protection.
  - .4 Class II ground fault protection.
  - .5 Selectable trip class.
  - .6 Selectable Automatic/Manual reset. Set to Manual.
  - .7 Manual reset pushbutton outside of enclosure.
  - .8 IEC rated to match starter.
  - .9 Acceptable material:
    - .1 Cutler-Hammer #C440.
    - .2 Siemens #3RB21.
    - .3 Schneider Tesys Solid State Series.
    - .4 Allen-Bradley Bulletin #193-EGF/193-CBCT.
- .3 Power and control terminals.
- .4 Wiring and schematic diagram inside starter enclosure in visible location.
- .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fusible disconnect with operating lever on outside of enclosure and provision for:
- .1 Locking in "OFF" position with up to 3 padlocks.
- .2 Independent locking of enclosure door.
- .3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:
- .1 Pushbuttons/Hand-off-Auto Selector switches: heavy duty, oil tight, labelled as indicated.
- .2 Indicating lights: heavy duty LED type and color as indicated.
- .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.4 Acceptable material:
- .1 Cutler-Hammer #XT Series.
- .2 Schneider #LE1 Series.
- .3 Siemens #V4AB Series.
- .4 Allen-Bradley Bulletin #112.

2.5 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 24 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.6 ENCLOSURE

.1 Enclosure: CSA type 1 unless indicated otherwise.

2.7 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
.2 Manual starter and switch designation label, white plate, black letters, size 1, engraved as indicated.
.3 Magnetic starter designation label, white plate, black letters, size 1 engraved as indicated.

2.9 EXTRA MATERIALS [DESIGN NOTE: OPTIONAL]

.1 Provide listed spare parts for each different size and type of starter if applicable for the particular starter.
    .1 Three (3) contacts; stationary.
    .2 Three (3) contacts; moveable.
    .3 One (1) contact; auxiliary.
    .4 One (1) control transformer.
    .5 Two (2) fuses.
    .6 One (1) operating coil.
    .7 10% of indicating lamps used.

3 Execution

3.1 INSTALLATION

.1 Prior to installation verify motor sizes with division supplying motor to ensure starter and overload relay match equipment being supplied.
.2 Install starters, connect power and control as indicated.
.3 Ensure correct fuses and overload devices elements installed. Adjust overload relay settings or install new thermal overload onsite to match motor nameplate.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and manufacturer's instructions.
.2 Operate switches, contactors to verify correct functioning.
.3 Perform starting and stopping sequences of contactors and relays.
.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

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1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI).
  .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
  .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
  .1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.

.3 Illuminating Engineering Society of North America (IESNA).
  .1 LM-79, Photometric Measurements of Solid State Lighting Products.
  .2 LM-80, Measuring Lumen Maintenance of LED Light Sources.
  .3 TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.

.4 United States of America, Federal Communications Commission (FCC).
  .1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.3 SUBMITTALS

.1 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Owner’s Representative.

.2 Photometric data to include: VCP Table and spacing criterion and luminaire coefficient of utilization (CU) tables and/or electronic IES files.

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

.4 Quality assurance submittals: provide the following in accordance with Section 01 45 00 - Quality Control.
  .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation, wiring, operation and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 - General Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Disposal and recycling of fluorescent lamps and ballasts as per local regulations, and in accordance with Section 26 05 03 - Electrical Removals and Alterations.

1.5 ACCEPTABLE MATERIAL

.1 Luminaires described in the Luminaire Schedule identify the minimum standard of quality and performance criteria which is acceptable for product. Named fixtures are acceptable with modifications and accessories as indicated.

.2 Fixtures from other manufacturers may be acceptable provided:
  .1 Appearance and lighting performance are similar.
  .2 Quality is equal or better.
  .3 Luminaire performance is equal or better.
  .4 The fixture is provided with modifications and accessories to provide a complete product in keeping with the intent of the project.
  .5 Approval in writing is obtained from the Consultant to the Contractor five (5) days prior to tender closing date.

2 Products

2.1 LED DRIVERS

.1 Power supply units including drivers:
- .1 Minimum efficiency of 85%.
- .2 Operate between -40°C and +50°C.
- .3 120 V (±10%) input voltage; UL Class 1 or 2 output.
- .4 Dimmable where indicated in Luminaire Schedule
- .5 Power factor greater than or equal to 0.90; total harmonic distortion less than or equal to 20%.
- .6 Located with luminaire housing or remote as indicated.
- .7 Minimum five (5) year warranty.

2.2 LED LUMINAIRES

.1 Proposed equal fixtures not listed in the Luminaire Schedule must meet or exceed the overall performance requirements of the specific space without requiring changes to designed branch circuiting due to higher power consumption.

.2 Luminaire efficacy to be a minimum of 90 lumens/watt, unless noted otherwise in the Luminaire Schedule.

.3 Color rendering index to be a minimum of 70 for outdoor and high bay lighting and 80 for indoor lighting.

.4 Color temperature as indicated in the Luminaire Schedule.

.5 Luminaire shall be tested using IESNA LM-79-08, in situ temperature measurement test (ISTMT) and IESNA LM-80-08 in an EPA recognized laboratory.

.6 A minimum of L70 = 50,000 hours or L90 = 36,000 hours as calculated using IESNA TM-21-11 standard.

.7 Luminaire distribution to be as indicated on the Luminaire Schedule.

.8 Minimum five (5) year warranty on complete LED system including LED modules and driver.

.9 Behavioural Health rated and / or washdown rated luminaires as indicated in the Luminaire Schedule and on the Drawings.

2.3 FINISHES

.1 Light fixture finish as indicated in Luminaire Schedule. Finish to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

.1 As indicated in Luminaire Schedule on drawings. Provide two (2) spare Type A1 & A2 luminiaires.

2.5 SPARE MATERIALS

.1 Three (3) spare Type A2 luminiares.

.2 Two (2) spare Type C2 luminaires.

3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated on the drawings and in accordance with manufacturers installation instructions.
- .1 Provide adequate support to suit ceiling system and weight of luminaire.
- .2 Provide additional securing brackets, clips, gripple loops, etc. as required to secure Behavioural Health luminiaires.

3.2 WIRING

.1 Connect luminaires to lighting circuits.

.1 Install flexible conduit for vertical power supply drop to luminaires as indicated. Horizontal wiring using flexible conduit is not permitted.

3.3 LUMINAIRE SUPPORTS

.1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.

.2 Provide additional supports connected directly to building structure as required by manufacturer. Coordinate installation of additional support infrastructure with General Contractor prior to installation of suspended ceiling grid.

.3 Provide and install additional supports for vandal resistant or ruggedized luminiaires in accordance with the Manufacturer's installation instructions. Coordinate installation on site.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical

3.6 CLEANING

.1 Luminaire lenses, housings, louvers, etc., are to be cleaned upon completion of construction in accordance with Division 01 - General Requirements.

END OF SECTION

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1 General

1.1 LUMINIARE SCHEDULE

TYPE	DESCRIPTION	SOURCE	MOUNTING
A1	600 x 600 x 60mm LED FLAT PANEL c/w WHITE POWDER COAT STEEL FRAME, IMPACT RESISTANT ACRYLIC WHITE SATIN LENS, C/W SCREW-ON RETENTION CLIPS FOR ADDED RESILIENCY, 0-10VDC DIMMABLE TO 10%, 120V DRIVER. LITHONIA #CPX-2X2-3200LM-80CRI-40K-SWL-MIN10-MVOLT-GZ10-LP840 c/w C. CLIP METALUX # 22FP3240C c/w RETENTION CLIP CFI #2FPZ38L-840-2-DS-UNV-DIM	LED 3200 LUMENS 25W 4000K 80 CRI	RECESSED IN T-BAR CEILING C/W SCREW ON RETENTION CLIPS
A2	600 x 600 x 60mm LED FLAT PANEL c/w WHITE POWDER COAT STEEL FRAME, IMPACT RESISTANT ACRYLIC WHITE SATIN LENS, 0- 10VDC DIMMABLE TO 10%, 120V DRIVER. LITHONIA #CPX-2X2-4000LM-80CRI-40K-SWL-MIN10-MVOLT-GZ10-LP840 METALUX # 22FP4240C CFI #2FPZ45L-840-2-DS-UNV-DIM	LED 4000 LUMEN 31W 4000K 80 CRI	RECESSED IN T-BAR CEILING
A3	1200 x 600 x 60mm LED FLAT PANEL c/w WHITE POWDER COAT STEEL FRAME, IMPACT RESISTANT ACRYLIC WHITE SATIN LENS, 0- 10VDC DIMMABLE TO 10%, 120V DRIVER. LITHONIA #CPX-2X4-6000LM-80CRI-40K-SWL-MIN10-MVOLT-GZ10-LP84 METALUX # 24FP6440C CFI #4FPZ60L-840-2-DS-UNV-DIM	LED 6000 LUMEN 60W 4000K 80 CRI	RECESSED IN T-BAR CEILING.
A4	600 x 600 x 60mm LED FLAT PANEL c/w WHITE POWDER COAT STEEL FRAME, IMPACT RESISTANT ACRYLIC WHITE SATIN LENS, C/W SCREW-ON RETENTION CLIPS FOR ADDED RESILIENCY, 0-10VDC DIMMABLE TO 10%, 120V DRIVER. LITHONIA #CPX-2X2-3200LM-80CRI-40K-SWL-MIN10-MVOLT-GZ10-LP840 c/w C. CLIPP METALUX # 22FP3240C c/w RETENTION CLIP CFI #2FPZ38L-840-2-DS-UNV-DIM	LED 3200 UMEN 25W 4000K 80 CRI	RECESSED IN GYPSUM DRYWALL CEILING

TYPE	DESCRIPTION	SOURCE	MOUNTING
B1	1200 x 300 x 60mm LED FLAT PANEL c/w WHITE POWDER COAT STEEL FRAME, IMPACT RESISTANT ACRYLIC WHITE SATIN LENS, 0- 10VDC DIMMABLE TO 10%, 120V DRIVER. LITHONIA #CPX-1X4-3200-80-40K-SWL-MIN10-ZT-MVOLT METALUX # 14FP6440C CFI #1FPZ-32L-840-4-DS-UNV-DIM	LED 3200 LUMEN 29 W 4000K 80 CRI	RECESSED IN GYPSUM CEILING
B2	1200 x 300 x 60mm LED FLAT PANEL c/w WHITE POWDER COAT STEEL FRAME, IMPACT RESISTANT ACRYLIC WHITE SATIN LENS, 0-10VDC DIMMABLE TO 10%, 120V DRIVER. LITHONIA #CPX-1X4-5000-80-40K-SWL-MIN10-ZT-MVOLT METALUX # 14FP6440C CFI #1FPZ-50L-840-4-DS-UNV-DIM	LED 5000 LUMENS 40W 4000K 80 CRI	RECESSED IN T-BAR OR GYPSUM CEILING AS INDICATED ON DRAWINGS. PROVIDE DRYWALL FRAME KIT AS REQUIRED.
C1	1200 x 300 x 125mm IMPACT RESISTANT AND ANTI-LIGATURE RATED LED LUMINAIRE. WELDED AND DIE-FORMED 16GA PAINTED STEEL FRAME, FLAT IMPACT RESISTANT 0.25" FROSTED POLYCARBONATE LENS, FLANGE MOUNT WITH SCREW DOWN CLIPS FOR ADDED SECURITY. EXPOSED HARDWARE TORX TYPE. 120V DRIVER, 0-10VDC DIMMABLE TO 10%. WASHDOWN RATED FOR BEHAVIORAL HEALTHCARE APPLICATIONS. PROVIDE ADDITIONAL SUPPORT AS REQUIRED TO SUPPORT WEIGHT OF LUMINIARE IN GYPSUM CEILING FAILSAFE #FMR-D12-4-LD4-2LO-40-UNV-80/86-EDD1 c/w VRSD KENALL #RMAC14-F-1-9-FA-55C-37K8-DCC-DV-IF Luminaire LED # RMP-R14-F -H16CRSP-PRD-5000LM-40K-MVOLT-BLS- 5ES-AMF-WL-YM	LED 5000 LUMENS 55W 4000K 80 CRI	RECESS IN DRYWALL CEILING WITH SCREWDOWN SECURITY CLIPS
C2	1200 x 300 x 125mm IMPACT RESISTANT AND ANTI-LIGATURE RATED LED LUMINAIRE. WELDED AND DIE-FORMED 16GA PAINTED STEEL FRAME, FLAT MPACT RESISTANT 0.5" FROSTED POLYCARBONATE LENS, FLANGE MOUNT WITH SCREW DOWN CLIPS FOR ADDED SECURITY. EXPOSED HARDWARE TORX TYPE. 120V DRIVER, 0-10VDC DIMMABLE TO 10%. WASHDOWN RATED FOR BEHAVIORAL HEALTHCARE APPLICATIONS. PROVIDE ADDITIONAL SUPPORT AS REQUIRED TO SUPPORT WEIGHT OF LUMINIARE IN GYPSUM CEILING FAILSAFE #FMR-D12-4-LD4-2STD-40-UNV-80/88-EDD1 c/w VRSD KENALL #RMCA-4-FL/SA-7-67L40K-DCC-DV-J-1-WL Luminaire LED # RMP-R14-F -H16CRSP-PRD-5500LM-40K-MVOLT-BLS- 9ES-AMF-WL-YM	LED 5500 LUMEN 55W 4000K 80 CRI	RECESS IN DRYWALL CEILING WITH SCREWDOWN SECURITY CLIPS

TYPE	DESCRIPTION	SOURCE	MOUNTING
C3	600 x 600 x 125mm IMPACT RESISTANT AND ANTI-LIGATURE RATED LED LUMINAIRE. WELDED AND DIE-FORMED 16GA PAINTED STEEL FRAME, FLAT IMPACT RESISTANT 0.25" FROSTED POLYCARBONATE LENS, FLANGE MOUNT WITH SCREW DOWN CLIPS FOR ADDED SECURITY. EXPOSED HARDWARE TORX TYPE. 120V DRIVER, 0-10VDC DIMMABLE TO 10%. WASHDOWN RATED FOR BEHAVIORAL HEALTHCARE APPLICATIONS. PROVIDE ADDITIONAL SUPPORT AS REQUIRED TO SUPPORT WEIGHT OF LUMINIARE IN GYPSUM CEILING FAILSAFE #FMR-D24-2-LD4-2HI-40-UNV-80/86-EDD1 c/w VRSD KENALL #RMCA-4-FL/SA-7-67L40K-DCC-DV-J-1-WL Luminaire LED # RMP-R22-F-H16CRSP-PRD-5000LM-40K-MVOLT-BLS- 5ES-AMF-WL-YM	LED 5000 LUMEN 43W 4000K 80 CRI	RECESS IN DRYWALL CEILING WITH SCREWDOWN SECURITY CLIPS
C4	1200 x 300 x 125mm IMPACT RESISTANT AND ANTI-LIGATURE RATED LED LUMINAIRE. WELDED AND DIE-FORMED 16GA PAINTED STEEL FRAME, FLAT IMPACT RESISTANT 0.25" FROSTED POLYCARBONATE LENS, FLANGE MOUNT WITH SCREW DOWN CLIPS FOR ADDED SECURITY. EXPOSED HARDWARE TORX TYPE. 120V DRIVER, 0-10VDC DIMMABLE TO 10%. WASHDOWN RATED FOR BEHAVIORAL HEALTHCARE APPLICATIONS. PROVIDE ADDITIONAL SUPPORT AS REQUIRED TO SUPPORT WEIGHT OF LUMINIARE IN GYPSUM CEILING FAILSAFE #FMR-D12-4-LD4-1HI-40-UNV-80/86-EDD1 c/w VRSD KENALL #RMAC14-F-1-9-FA-55C-37K8-DCC-DV-IF Luminaire LED # RMP-R14-F -H16CRSP-PRD-4000LM-40K-MVOLT-BLS- 5ES-AMF-WL-YM	LED 4000 LUMENS 43W 4000K 80 CRI	RECESS IN DRYWALL CEILING WITH SCREWDOWN SECURITY CLIPS
D1	100mm DIAMETER, RECESS MOUNTED LED DOWNLIGHT C/W MEDIUM WIDE DISTRIBUTION, SELF-FLANGED AND SEMI-SPECULAR CLEAR REFLECTOR, 0-10VDC DIMMABLE TO 10%, 120V DRIVER. HALO #HC415D010/41MDC LITHONIA #LDN4 40/15 L04AR LSS MVOLT GZ1 LIGHTOLIER #4RN-C4L15840WZ10U-C4RDLCC	LED 1500 LUMENS 18W 4000K 80 CRI	RECESSED IN T-BAR CEILING
E1	LOW PROFILE 450 x 220 x 90mm SURFACE MOUNTED EXTERIOR LUMINAIRE. DIE CAST ALUMINIUM HOUSING, POWDER COATED WHITE, TYPE 5 WIDE DISTRIBUTION, IMPACT RESISTANT AND GASKETTED ACRYLIC LENS. RATED TO -40C AMBIENT TEMP. LITHONIA#VCPG-V4-P5-40K-80CRI-T5W-MVOLT-SRM-UPL1-DBLXD McGRAW #CNC-F02-LED-E03-RW-BK-SM GARDCO #G3-A04-740-5SQ-SBO-UNV-BK	LED 9000 LUMENS 75W 4000K 80 CRI	SURFACE MOUTNED TO UNDERSTIDE OF CANOPY. T&G PVC CEILING.

TYPE	DESCRIPTION	SOURCE	MOUNTING
E2	450 x 300 x 175mm EXTERIOR LED WALL PACK, DIE-CAST HOUSING, TYPE 4 FORWARD THROW OPTIC, BLACK POWDER COAT FINISH, 120V DRIVER. COOPER #XTOR LITHONIA #WPX3 LED 40K MVOLT DBLXD KEENE #LPW32-70-NWG3-4-UNV-BK	LED 7450 LUMENS 59W 4000K 80 CRI	WALL MOUNTED TO EXTERIOR FAÇADE OF BUILDING. MOUNTING ELEVATION AS INDICATED ON THE DRAWINGS
E3	450 x 300 x 175mm EXTERIOR LED WALL PACK, DIE-CAST HOUSING, TYPE 4 FORWARD THROW OPTIC, BLACK POWDER COAT FINISH, 120V DRIVER. COOPER #XTOR2B LITHONIA #WPX1 LED 40K MVOLT DBLXD KEENE #LPW16-20-NW-G3-4-UNV-BK	LED 1500 LUMENS 18W 4000K 80 CRI	WALL MOUNTED TO EXTERIOR FAÇADE OF BUILDING. MOUNTING ELEVATION AS INDICATED ON THE DRAWINGS
F1	2440 x 230 x 53mm, SUSPENDED DIRECT/INDIRECT LINEAR LED c/w ALUMINIUM FINISH STEEL HOUSING AND FLAT END CAPS, 20% UP AND 80% DOWN DISTRIBUTION, 900mm ADJUSTABLE SUSPENSION CABLES, 0-10V DIMMING TO 1%, 120V DRIVER. MARK #PLN8-LLP-8FT-MSL8-80CRI-40K1D1300LMF-20/80-SCT-MIN1-MVOLT-WHSG-ZT-FLEP CORELITE #i3-WL-50L840-1D-UNV-STD-W-AC48-T1-8 LEDALITE #7406-L-B-A-Q-G-08-7-D-E-W-A6-1-96	LED 1300 LUMENS / FT 59W 4000K 80 CRI	SUSPENDED AT 2400mm AFF. COORDINATE EXACT LOCATION AND SUSPENSION HEIGHT WITH DEPARTMENTAL REP. ON SITE
G1	30 x 30 x 600 mm SURFACE MOUTNED UNDERCABINET LINEAR LED c/w INTEGRAL 120V DRIVER OR REMOTE DRIVER KIT, SEMI-SPECULAR FROSTED REFLECTOR, AND ALL ASSOCIATED CONNECTORS, CABLES AND MOUNTING HARDWARE REQUIRED FOR FULLY OPERATIONAL AND CONCEALED UNDERCABINET LIGHTING SYSTEM. LIGHT EFFICIENT DESIGN #RP-LBI-G1-2F-10W-40K-WC AXIS #BCUCRUN2380w120-RDE14(59") CFI #LINCS100E-L28-UNV-WHG-DIM-RSW	LED MIN 1000L / 2FT 12W 4000K 80 CRI	SURFACE MOUNTED TO UNDERSIDE OF CASE WORK.

TYPE	DESCRIPTION	SOURCE	MOUNTING
H1	85 x 80 x 265 mm RECESS MOUNTED LED NIGHT LIGHT c/w 120V DRIVER, AMBER LED SOURCE, POLYCARBONATE LENS AND SLOTTED REFLECTOR, WASHDOWN AND BEHAVIOURAL HEALTH RATED WITH 16-GA 304 SS, ANTIMOCROBIAL POLYESTER POWDER COAT WHITE FRAME AND LOUVER. ALL EXPOSED HARDWARE TO BE TAMPER RESISTANT TYPE AND ANTI-LIGATURE FLUSH FRAME. KENALL #MSL-L-3-BSS-2-ALL-WHL-120-2-BH AXIS #BCSSRHAMBAMWUNV HEALTH CARE LIGHTING #HNLS13-9LONG-MVOLT-AMB-ZT-MIN5-WL- GWAM-TRS	AMBER LED	SURFACE MOUNTED AT 450mm AFF IN GYPSUM DRYWALL
J1	1200 x 75 X 75 mm SUSPENDED LED STRIP LUMINAIRE c/w FROSTED ACRYLIC ROUND WIDE DISTRIBUTION LENS, POWDER COATED STEEL HOUSING AND CHAIN SUSPENSION KIT AND HANGERS. LITHONIA #CLX-L48-5000LM-SEF-RDL-WD-MVOLT-40K-80CRI METALUX #4ST2L5040R CFI #FSS-455-L840-UNV	LED 5000 LUMENS 45W 4000K 80 CRI	SUSPENDED AT 3000mm AFF. COORDINATE EXACT LOCATION AND SUSPENSION HEIGHT WITH DEPARTMENTAL REP. ON SITE.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
  .2 CSA C860, Performance of Internally-Lighted Exit Signs.
.2 National Fire Protection Association (NFPA), NFPA 101, Life Safety Code.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements:
  .1 Product data to include performance criteria, physical size, finish and limitations.
.2 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and disposal.

2 Products

2.1 EXIT SIGNS

.1 Exit signs: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Electrical Code for Preferred Packaging guidelines.
.2 120V VAC normal power.
.3 Housing: white thermoplastic.
.4 Face: Edge lit acrylic with pictorial white running man on green face with chevrons as indicated on drawings.
.5 Lamps: multiple - LED, 4 W.
.6 10 years unconditional Parts and Labour Warranty.
.7 Double or single face, universal wall or ceiling mounted as indicated on the drawings.
.8 Acceptable material:
  .1 Lumacell #LP Series.
  .2 Ready-Lite #RP Series.
  .3 Aim-Lite #RPPL Series.
  .4 Stanpro #RMPN Series.

2.2 BEHAVIOURAL HEALTH EXIT SIGNS

.1 Exit signs: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Electrical Code for Preferred Packaging guidelines.
.2 120V VAC normal power.
.3 Housing: white thermoplastic.
.4 Face: Edge lit acrylic with pictorial white running man on green face with chevrons as indicated on drawings.
.5 Lamps: multiple - LED, 4 W.
.6 10 years unconditional Parts and Labour Warranty.
.7 Double or single face, universal wall or ceiling mounted as indicated on the drawings.
.8 Exit signs located in Corridors 5660 and 5630 are to be anti-ligature type and ruggardized for use in Behavioural Health applications.
.9 Acceptable material:
  .1 Lumacell #LN10 Series.
  .2 Ready-Lite #RN10 Series.
  .3 AimLite #RPVR Series.

3 Execution

3.1 INSTALLATION

.1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
.2 Connect fixtures to exit light circuits using RW90 wire in EMT conduit.
.3 Ensure that exit light circuit breaker is locked in on position and painted red.
.4 Provide tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

3.2 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management.
.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.
.2 Section 26 05 28 – Grounding – Secondary.

1.2 REFERENCES

.1 American National Standards Institute.
  .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
.2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA).
  .1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 SYSTEM DESCRIPTION

.1 Telecommunications grounding and bonding system consist of bonding backbones, and other bonding conductors and jumpers.
.2 Provides ground reference for all new and modified telecommunications systems within the Hospital.
.3 Metallic pathways, cable shields, conductors, and hardware associated with new telecommunications systems are bonded to the existing telecommunications main grounding busbar located in Communications Room #71037.
.4 To be supplied and installed in accordance with the Government of Prince Edward Island Structured Cabling Standards (February 26, 2016), located in the Appendices section of the specifications.

2 Products

2.1 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)

.1 Copper conductor, green insulated marked to: ANSI J-STD-607-A, size as indicated.

2.2 WARNING LABELS

.1 Non-metallic warning labels in English to: ANSI J-STD-607-A.
.2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

3 Execution

3.1 BONDING CONDUCTORS GENERAL

.1 Ensure all data/ telephone system conduits are properly grounded. For conduit drops at workstation locations and for sleeves, install ground bushings and a #14 AWG bare bonding conductor to closest grounded raceway or junction box.

3.2 BONDING FOR TELECOMMUNICATIONS

.1 Bond metallic raceways and data racks in telecommunications rooms to TMGB using #6 AWG green insulated copper conductor.
.2 For cables within telecommunications rooms having shield or metallic member, bond shield or metallic member to TMGB using #6 AWG green insulated copper conductor.

3.3 LABELLING

.1 Apply warning labels to telecommunications bonding and grounding conductors.

.2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.
.2 Section 26 05 31 - Junction and Pull Boxes.
.3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 SYSTEM DESCRIPTION

.1 Telecommunications pathway system consists of outlet boxes, conduits, pull boxes, fish wires, J-hooks and cable tray.
.2 To be supplied and installed in accordance with the Government of Prince Edward Island Structured Cabling Standards (February 26, 2016), located in the Appendices section of the specifications.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

2 Products

2.1 MATERIAL

.1 Conduits: type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
.2 Outlet boxes: 100mm square with single device cover and fittings: in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
.3 J-hook support clips: Caddy “CableCat Clip” or approved equal.
.4 Velcro cable ties: Panduit #HLS-15RO or approved equal.

3 Execution

3.1 INSTALLATION

.1 Install raceway system, including outlet boxes, conduit, miscellaneous and positioning material to constitute complete system.
.2 Install conduit from data/telephone outlet box locations to accessible corridor ceiling space. Use 27mm EMT. Use 100mm x 100mm x 50mm device boxes with single gang plaster rings at outlet box locations.
.3 Ensure all data/ telephone system conduits are properly grounded. Where required, install ground bushings and a #14 AWG bare bonding conductor to closest grounded raceway or junction box.
.4 Communications conduits in telecommunications rooms are to be bonded to ground in accordance with Section 27 05 26 - Grounding and Bonding for Communications Systems.
.5 Install new structured cables in existing cable tray where indicated. Neatly bundle, organized and secure with velcro ties.
.6 Dress cabling using Velcro cable ties. The use of nylon or plastic ties is not permitted.
.7 Cable management in accessible ceiling spaces.
  .1 J-hook supports as required to support loose cable bundles at 1000 mm maximum spacing to point of entry into conduit system.

.2 Provide support for individual cables using caddy clips at 1000 mm maximum spacing to point of entry into conduit system.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.
.2 Section 27 05 28 – Grounding - Secondary.

1.2 REFERENCES

.1 Canadian Standards Association
  .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  .2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  .3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair cables, terminations, connectors, cross-connection hardware and related equipment.
  .1 Telecommunication system to be supplied and installed in accordance with the Government of Prince Edward Island Structured Cabling Standards (February 26, 2016), located in the Appendices section of the specifications.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
.2 As-built Records and Drawings:
  .1 Provide and place one hard copy of as-built records in Communications Room #71037.

1.5 QUALITY ASSURANCE

.1 All cabling, termination hardware and connecting cords to be sourced from a certifying manufacturer to assure quality control.
.2 The system is to have an end-to-end 20-year warranty against defects in materials and labour. Certified system vendor to repair or replace any failed component, including labour at no cost to the Owner. Provide system test results, certificates and warranty in Maintenance Manuals.

2 Products

2.1 HORIZONTAL DATA/TELEPHONE CABLES

.1 CSA certified Type FT6 in accordance with CAN/CSA-C22.2 No. 214-02.
.2 Meets or exceeds Category 6 requirements of CAN/CSA T568.1-05 for data, and telephone.
.3 Construction:
  .1 Conductors: 24 AWG annealed copper, four individually twisted pair.
  .2 Insulation: PE, colour coded, Type CMP.
  .3 Jacket:
    .1 PVC jacket – green for data, white for telephone, yellow for WAP, purple for CCTV.
    .2 Jacket slitting cord.

.3 Jacket printed at intervals not exceeding 300mm indicating cable code, AWG, UL and CSA designations and quarter and year of manufacture.

.4 Acceptable manufacturer (CAT 6):

.1 Belden #4813 LX (data, WAP, CCTV), #2413 (telephone).

2.2 DATA/TELEPHONE OUTLETS

.1 Single or multi outlets as indicated, CSA listed.

.2 Rated for Category 6.

.3 Meets or exceeds Category 6 requirements of CAN/CSA T568.1-05.

.4 Wiring configuration: T568A (ISDN).

.5 Suitable for flush mounting in single gang coverplate.

.6 Modular outlet color: green for data, white for telephone, yellow for WAP, purple for CCTV.

.7 4-port white interface plate. Provide blanking fillers for unused ports. Interface plate to accept Category 6 modular outlets. Where required, provide interface plates that support additional modular outlets.

.8 Acceptable manufacturer or approved equal:

.1 Belden PS6+ MOVO modules c/w 4 port Belden #A0645269 faceplate.

2.3 CABLE SUPPORTS

.1 J-hook support clips, Caddy "CableCat Clip" or approved equal at 2' spacing.

.2 Panduit Velcro brand "HLS-15RO" cable ties or approved equal at 4' spacing.

.3 Conduit in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

.4 Pathways in accordance with Section 27 05 28 – Pathways for Communications Systems.

2.4 UTP CROSS-CONNECT PATCH CORDS

.1 Patch cords to be supplied at the rack and individual outlets, with factory-installed male plugs at each end to mate with RJ-45 jacks, Category 6, 4 pairs to: TIA/EIA-568-B.2.

.2 Acceptable manufacturer or approved equal:

.1 Belden GigaFlex PS6+.

.3 Provide patch cords for each data drop and each telephone drop. Patch cord jackets to be blue for data, white for telephone.

.4 Patch cord lengths to be:

.1 4', 70% ot total count.

.2 7', 20% of total count.

.3 10', 10% of total count.

2.5 PATCH PANELS

.1 Category 6 modular patch panels, rack mounted, black in color complete with mounting hardware.

.2 48 port port patch panels as indicated with T568A-ISDN wiring assignment. Patch panels to be supplied fully populated with outlets.

.3 Mounts in two rack space units (2RU) of a EIA-310-D compliant rack.

.4 Front and rear port identification complete with labels. Labeling to be coordinated with ITSS.

.5 Connectors:

.1 Punch down UTP connector, modular, insulation displacment connection type.

.2 Front with fully recessed clips.

.3 Built-in wire pair splitters.

.6 Acceptable manufacturer:

.1 Belden 48 port FLEX Patch Panel, #AX101458.

2.6 TERMINATION EQUIPMENT FOR TELEPHONE CONDUCTORS

.1 Terminate telephone cables on existing BIX wall mount system in existing Communications Room. Provide additional components as required.

.2 Wall mount cross connect system comprised of the following componets:

- .1 Distribution connectors for 25 pair connections (Belden #QCBIX1A4).
- .2 Mounts for twenty connectors (Belden #QMBIX10A).
- .3 Designation labels (Belden #P0731972 & P0731975).
- .4 Designation strips (Belden #AX101483).
- .5 Distribution rings (Belden #AX101486).

2.7 IDENTIFICATION

.1 Each modular jack to be identified with an alpha/numeric label. To match the Hospitals existing identification scheme. Coordinate with ITSS on site.

.2 Each horizontal cable to have identification markers installed on both ends.

.3 Each patch panel or termination block to have corresponding labelling.

.4 Labelling to indicate rack number, patch panel letter and outlet number.

3 Execution

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination and cross-connect hardware on wall or in rack as indicated and according to manufacturers' instructions.

.2 Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL CABLES

.1 Install horizontal cables as indicated in cable tray conduits, and "J" hooks to outlets. Identify and label as indicated to: TIA/EIA-606-A.

- .1 Where raceways are used to distribute cables to each zone, provide supplementary "J" hooks to support cables at intervals not exceeding 1m.

.2 Terminate horizontal cables in telecommunications room and at individual work-area jacks.

- .1 Identify and label as indicated to: TIA/EIA-606-A.

.3 Harness slack cable in cabinets and wall-mounted termination and cross-connection hardware.

3.3 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using jumper wires as specified.

3.4 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies. Provide a record of results both hard copy and electronic on CD.

- .1 Perform the following tests:
  - .1 Contractor to test the permanent link using the specficiations for the installed Category 6 cables. Test must be completed using a Level IV meter that an authorized service centre has calibrated within the last 12 months.

END OF SECTION

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1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 ANSI S1.4-1983(R2004), American National Standard Specification for Sound Level Meters.
- .2 ANSI S1.11-1986(R2004)/ASA 65, American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters.
- .3 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM E1041- 85 Standard Guide for Measurement of Masking Sound in Open Offices.
- .2 ASTM E1573-09 Standard Test Method for Evaluating Masking Sound in Open Offices, Using A-Weighted and One-Third Octave Band Sound Pressure Levels.
- .3 ASTM E1130-08 Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Method.
- .4 ASTM E 1374-02 Standard Guide for Open Office Acoustics and Applicable ASTM Standards

.3 International Electro-technical Vocabulary (IEC):
- .1 IEC 651, Live Working.

1.2 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEZEE SP1122.

1.3 DESCRIPTION OF A DIGITAL WIRELESS SINGLE ZONE MASKING SYSTEM

.1 An electronic, frequency contoured sound masking system which includes the following:
- .1 Strategically located speaker assemblies installed above conventional suspended acoustic tile ceiling in areas indicated.
- .2 Speaker assemblies generating unique, diffuse and unobtrusive sound with spatial and temporal uniformity, and having a spectrum shape designed to mask speech and low level unwanted noise.
- .3 System Components Must Include: The Vibra–Sonic, Digital Sound Masking System is based on the DSP 110 Processor. It is a self contained single-zone digital DSP-GUI controlled processor with Digital Class D Amplifiers, Third Octave 31 Band Equalizers, Power, all onboard.
- .4 Processor must be housed in a 4.5”w x 1”h (11.5 cm x 2.75 cm) speaker or wall mountable chassis that is black powder coat CRS cold roll steel.
- .5 Must include an 11” (28 cm) bracket for speaker or wall mounting.
- .6 The system shall be (1) programmable channel and serve a single Zone up to 15 speakers.
- .7 Each DSP110 must have one 1/3 octave band equalizer allowing the development of 1 sound masking spectrum.

1.4 PERFORMANCE REQUIREMENTS

.1 Provide sound masking in accordance with the system description to all areas indicated on drawings and/or schedule. Sound level performance shall comply with the following one-third octave sound pressure levels and tolerances:

1/3 Octave ISO Centre Frequency	1/3 Octave Band Sound Pressure Levels	Tolerances

(Hz)	(dB)	(± dB)
125	44	± 3
160	43	± 3
200	42	± 2-3
250	41	± 1-2
315	40	± 1
400	39	± 1
500	37.5	± 1
630	36	± 1
800	34.5	± 1
1,000	33	± 1
1,250	31.5	± 1
1,600	30	± 1
2,000	28	± 1
2,500	26	± 1
3,150	24	± 1
4,000	22	± 1
5,000	20	± 1
6,300	17	± 1-2
8,000	14	± 1-2

Note: The above values are graphically illustrated on detail drawing 27 51 20.01.

.2 Spatial Average Overall Sound Pressure Levels: Minimum 43 decibels and maximum 45 decibels, A-weighted (dBA).

1.5 SUBMITTALS

.1 Provide requested items in accordance with Section 01 33 00 – Submittals.
.2 Submit shop drawings indicating proposed quantity and location of all system components and related wiring and accessories
.3 Obtain Departmental Representative's approval for any changes in quantity or location of sound masking units from Departmental Representative reviewed shop drawings.
.4 After completing installation, testing, adjusting and balancing, submit the following:
  .1 Project record drawings in the form of the above noted shop drawings, revised as necessary to accurately indicate locations of all system components, as installed.
  .2 Copy of all final sound pressure levels readings taken, including accurate description of reading locations and test methods and equipment used.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 – Quality Control.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of contract.

1.8 SYSTEM STARTUP

.1 Installer shall make measurements to verify that the installed sound masking system meets specified acoustical performance requirements with Departmental Representative.
.2 Verification by the Departmental Representative will be performed with mechanical systems shut down in area being tested.

.3 Verification will be performed with mechanical systems in full operation in area being tested.

1.9 OPERATING INSTRUCTIONS

.1 Testing, tuning, and balancing will be performed after normal working hours of facility users, or as otherwise required by Departmental Representative.
.2 Schedule testing, adjusting, and balancing will be performed after above-ceiling mechanical and electrical work, suspended acoustic tile ceiling, and sound masking system installation are complete.

2 Products

2.1 SPEAKER

.1 Cone: 100-200mm (3.9” – 7.9”), single, Low Q”.
.2 Frequency Response: 125-8000 Hz +/- 4dB on axis.
.3 Sensitivity: 94 dB EIA minimum.
.4 Power Handling: 5 watts EIA minimum.
.5 Resonant Frequency: 99 Hz maximum
.6 Mounting: four screws (studs) to grill cover.

2.2 TRANSFORMERS

.1 Type: 70.7volt
.2 Minimum Primary Power Taps: COM, 0.25, 0.5, 1, 2, 4 watts set with exterior switch.
.3 Mounting: directly to speaker frame.

2.3 SPEAKER ENCLOSURES

.1 Size: 300mm (11.8”) square (round) 100mm (3.9”) deep.
.2 Construction: 0.6mm (1/42”) minimum thickness sheet steel.
.3 Undercoating: factory applied to eliminate resonance.
.4 Mounting: Bracket

2.4 GRILLE COVERS

.1 Construction: one piece, 0.6mm (1/42”) minimum thickness sheet steel.
.2 Perforated speaker opening to suit speaker size.
.3 Four screw clip opening to enclosure.

2.5 MICRO PROCESSOR CONTROL

.1 The DSP110 digital processor/amp shall be capable of producing pink noise and 15 watts of amplification.
.2 The DSP is integrated in the self contained unit.
.3 The system shall be monitored and adjusted with a computer connected to the Nano Controller.
.4 Processing capacity: 264 MIPS, 528 MFLOPS sustained operation.
.5 Memory storage is non-volatile RAM (Random Access Memory) for all programs and set up parameters which are stored and recoverable during power outages for up to ten (10) years.
.6 DSP must be capable of control of volume and equalization for one zone.

2.6 POWER SUPPLY

.1 Input voltage: 85 to 264VAC.
.2 Output current: 0 to 1.56A continuous.
.3 Power factor: >.90 at full load.
.4 Overload protection: Shall incorporate current limit to protect from damage
.5 Power mains: I.T.E Power Supply 24V~0.0-.5A UL Listed.

2.7 NOISE GENERATION

.1 1 channel independent, uncorrelated full random non - repeating noise generation with constant energy per octave bandwidth.
.2 Minimum spectrum accuracy: 1 dB from 40-10,000 Hz.
.3 Repetition Rate: repeats every 271 hours.
.4 Mounting: Integrated within Digital Signal Processing.

2.8 EQUALIZER FILTERS

.1 Requirement on the output channel with control over 31 - 1/3 octave.
.2 Integrated within Digital Signal Processing unit.
.3 Equalization: 1/3 octave using ISO standard frequencies from 63-12, 500Hz minimum.
.4 Output: 600 ohms balanced and adjustable.
.5 Filters: adjustable minimum 20 dB adjustment per band.
.6 Level Tolerance: +/- 1 dB from 200-4000 Hz.
.7 Total Harmonic Distortion: less than 0.5% at full rated output.
.8 Equivalent Input Noise: less than –85 dBA from 20-20,000 Hz un- weighted.
.9 Output: transformer isolated.
.10 Front panel security cover.
.11 Mounting: Integrated in self contained unit

2.9 AMPLIFIERS

.1 1 Channel, CLASS D solid state, EIA rated
.2 Audio power handling: continuous for speaker load plus minimum 3 dB margin (single or multi-channel).
.3 Frequency response +/- 0.3 dB 20Hz – 20kHz at 100 Ohm
.4 Total Harmonic Distortion: less than 1% at 1kHz at rated output.
.5 Transformer Output: 25 volts
.6 Manual gain control adjustable to 34 dB
.7 Output Regulation within 2dB, from no load to full load.
.8 Power Supply: self-contained and CSA approved.
.9 Mounting: Integrated self contained unit to be mounted on an M1000 speaker or a wall.
.10 Input impedance: 50K Ohm.
.11 Output impedance: 0.08 Ohm.
.12 Carrier Frequency: 400 kHz.
.13 Constant voltage at 50 W.
.14 +/- 15 VDC and 100 kHz square sine wave
.15 Peak current: 1.2 Amps

2.10 MATERIALS

.1 All plastics shall meet UL94VO flammability rating.
.2 Cold roll steel - 18 AWG - .047” nominal.
.3 Black powder coat paint.
.4 Corrosion resistant.
.5 White silk screen on rear.
.6 Front LCD Lights.
.7 Wireless Antennae.

2.11 ACCEPTABLE MATERIALS

.1 Subject to compliance with requirements, products that may be incorporated into the Work include:

.1 NanoMaskIt Digital Centralized remote, Single Zone Sound Masking Systems as designed by Vibra-Sonic Control and Materials Handling Inc. Vancouver - (604) 294-9495 fax - (604) 294-8033 Calgary - (403) 217-3555 fax - (403) 237-5064

3 Execution

3.1 INSTALLATION

.1 Install system components above suspended ceiling in accordance with manufacturer's instructions and in a manner that will permit specified acoustical performance requirements will be met.
.2 Suspend sound masking units with mounting chains securely anchored to underside of structure. Ensure that there is no strain on any electrical wiring. Avoid mounting that could result in generation of vibration noise or distortion.
.3 Mount closed enclosure to radiate sound upward.
.4 Install centralized Single Zone Digital Signal Processors securely mounted to M1000 speaker in plenum.
.5 Ground audio system to building power supply ground.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer’s nameplates, CSA labels and identifications nameplates are visible and legible after equipment is installed

3.3 INSTALLATION, CABLE

.1 Avoid damage to cables. Provide adequate cable strain relief.
.2 Run cables parallel and perpendicular to building lines. Attach wiring to top of structural elements in a non-obstructive fashion. Secure every 2 meters and at changes in direction.
.3 Connect each speaker wire pair to one terminal pair on screw terminal blocks at plenum located NanoMaskIt.

3.4 LOCATION OF OUTLETS

.1 Indicated within Installation Information.

3.5 MOUNTING HEIGHTS

.1 Indicated within Installation Information.

3.6 TESTING, ADJUSTING, AND BALANCING

.1 Test, adjust, and balance system with mechanical system and other noise generating equipment shut down in areas receiving sound masking.
.2 Test, adjust, and balance system until sound spectrum and levels meet specified performance requirements. Adjust settings of installed units, relocate installed units, or add additional units, if and as required.
.3 Upon completion of tests, perform walk-through verification of areas that will be covered by sound masking. Adjust and re-test areas having abnormal characteristics or levels.

3.7 TESTS AND TEST METHODS

.1 Test to determine each zone’s octave band sound pressure levels. Take a series of readings for unit coverage area.
.2 Test to determine spatial average overall sound pressure levels. Take minimum of one reading for each enclosed room covered by sound masking and minimum of one reading per 20 m2 (215 ft2) of floor area in all open spaces covered by sound masking.
.3 Position of Measuring Microphone: 1220 mm (48”) above floor and minimum 1000 mm (40”) away from any sound reflecting surface, in locations representative of each area that are sound masked.

3.8 MEASURE SOUND PRESSURE LEVELS USING ONE OF FOLLOWING METHODS

.1 An Equivalent Continuous Sound Level (LEQ) mode for minimum interval of 15 seconds.
.2 IEC 651 'slow' time constant, average reading of the highest and lowest level during 15 second intervals.

3.9 TEST EQUIPMENT

.1 Sound Level Meter: to ANSI S1.4-1983, Type 1 or
.2 Octave Band Filter: to ANSI S1.11, Class II or better.
.3 Accuracy of Acoustic Calibrator: within ±0.3 dB at

END OF SECTION

1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 ANSI S1.4-1983(R2004), American National Standard Specification for Sound Level Meters.
- .2 ANSI S1.11-1986(R2004)/ASA 65, American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters.
- .3 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM E1041- 85 Standard Guide for Measurement of Masking Sound in Open Offices.
- .2 ASTM E1573-09 Standard Test Method for Evaluating Masking Sound in Open Offices, Using A-Weighted and One-Third Octave Band Sound Pressure Levels.
- .3 ASTM E1130-08 Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Method.
- .4 ASTM E 1374-02 Standard Guide for Open Office Acoustics and Applicable ASTM Standards.

.3 International Electro-technical Vocabulary (IEC):
- .1 IEC 651, Live Working.

1.2 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEZEE SP1122.

1.3 DESCRIPTION OF A DIGITAL CENTRALIZED MASKING/PA SYSTEM

.1 An electronic, frequency contoured sound masking system which includes the following:
- .1 Strategically located speaker assemblies installed above conventional suspended acoustic tile ceiling in areas indicated.
- .2 Speaker assemblies generating unique, diffuse and unobtrusive sound with spatial and temporal uniformity, and having a spectrum shape designed to mask speech and low level unwanted noise.
- .3 System Components Must Include: The Vibra–Sonic, Digital Sound Masking System is based on the DSP2210 Digital Signal Processor. It is a self-contained multi-zone digital DSP-GUI controlled processor with Digital Class D Amplifiers, Third Octave 31 Band Equalizers, Power, Public Address Paging and Music Inputs, all onboard.
- .4 Processor must be housed in a 19”w x 3.5”h (48.3 cm x 8.9 cm) - (2 Rack Units high) rack or wall mount chassis that is black powder coat CRS cold roll steel.
- .5 Must include adjustable brackets for 19” (48.3 cm) rack or wall mounting.
- .6 The system shall be (2) independent programmable channels.
- .7 Each channel must have independent equalization allowing separate sound masking spectrums for each zone.

1.4 PERFORMANCE REQUIREMENTS

.1 Provide sound masking in accordance with the system description to all areas indicated on drawings and/or schedule. Sound level performance shall comply with the following one-third octave sound pressure levels and tolerances:

1/3 Octave ISO Centre Frequency (Hz)	1/3 Octave Band Sound Pressure Levels (dB)	Tolerances (± dB)

125	44	± 3
160	43	± 3
200	42	± 2-3
250	41	± 1-2
315	40	± 1
400	39	± 1
500	37.5	± 1
630	36	± 1
800	34.5	± 1
1,000	33	± 1
1,250	31.5	± 1
1,600	30	± 1
2,000	28	± 1
2,500	26	± 1
3,150	24	± 1
4,000	22	± 1
5,000	20	± 1
6,300	17	± 1-2
8,000	14	± 1-2

Note: The above values are graphically illustrated on detail drawing 27 51 20.01.

.2 Spatial Average Overall Sound Pressure Levels: Minimum 43 decibels and maximum 45 decibels, A-weighted (dBA).

1.5 SUBMITTALS

.1 Provide requested items in accordance with Section 01 33 00 –Submittals.
.2 Submit shop drawings indicating proposed quantity and location of all system components and related wiring and accessories.
.3 Obtain Departmental Representative approval for any changes in quantity or location of sound masking units from Departmental Representative's reviewed shop drawings.
.4 After completing installation, testing, adjusting and balancing, submit the following:
  .1 Project record drawings in the form of the above noted shop drawings, revised as necessary to accurately indicate locations of all system components, as installed.
  .2 Copy of all final sound pressure levels readings taken, including accurate description of reading locations and test methods and equipment used.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 – Quality Control.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of contract.

1.8 SYSTEM STARTUP

.1 Installer shall make measurements to verify that the installed sound masking system meets specified acoustical performance requirements with Departmental Representative.
.2 Verification by the Departmental Representative will be performed with mechanical systems shut down in area being tested.
.3 Verification will be performed with mechanical systems in full operation in area being tested.

1.9 OPERATING INSTRUCTIONS

.1 Testing, tuning, and balancing will be performed after normal working hours of facility users, or as otherwise required by Departmental Representative.
.2 Schedule testing, adjusting, and balancing will be performed after above-ceiling mechanical and electrical work, suspended acoustic tile ceiling, and sound masking system installation are complete.

2 Products

2.1 SPEAKER

.1 Cone: 100-200mm (3.9" – 7.9"), single, Low Q".
.2 Frequency Response: 125-8000 Hz +/- 4dB on axis.
.3 Sensitivity: 94 dB EIA minimum.
.4 Power Handling: 5 watts EIA minimum.
.5 Resonant Frequency: 99 Hz maximum.
.6 Mounting: four screws (studs) to grill cover.

2.2 TRANSFORMERS

.1 Type: 70.7volt
.2 Minimum Primary Power Taps: COM, 0.25, 0.5, 1, 2, 4 watts set with exterior switch.
.3 Mounting: directly to speaker frame.

2.3 SPEAKER ENCLOSURES

.1 Size: 300mm (11.8") square (round) 100mm (3.9") deep.
.2 Construction: 0.6mm (1/42") minimum thickness sheet steel.
.3 Undercoating: factory applied to eliminate resonance.
.4 Mounting: Bracket

2.4 GRILLE COVERS

.1 Construction: one piece, 0.6mm (1/42") minimum thickness sheet steel.
.2 Perforated speaker opening to suit speaker size.
.3 Four screw clip opening to enclosure.

2.5 MICRO PROCESSOR CONTROL

.1 The DSP2210 digital processor/amp shall be capable of automatic mixing, set-up and administration of all 2 inputs per zone via GUI from a desktop PC or laptop.
.2 The DSP is integrated within the self contained unit.
.3 The system shall be monitored and adjusted with a computer from a centralized control area.
.4 Processing capacity: 264 MIPS, 528 MFLOPS sustained operation.
.5 Memory storage is non-volatile RAM (Random Access Memory) for all programs and set up parameters which are stored and recoverable during power outages for up to ten (10) years.
.6 DSP must be capable of control of volume and equalization of zonal PA and music, if required initially on project or at some future date.

2.6 POWER SUPPLY

.1 Input voltage: 85 to 264VAC
.2 Output current: 0 to 1.56A continuous
.3 Power factor: >.90 at full load
.4 Overload protection: Shall incorporate current limit to protect from damage.
.5 Power mains: IEC 3-pin with ground.
.6 Packaging: Integrated within 1RU metal chassis.

2.7 NOISE GENERATION

.1 2 channel independent, uncorrelated full random non - repeating noise generation with constant energy per octave bandwidth.
.2 Minimum spectrum accuracy: 1 dB from 40-10,000 Hz
.3 Repetition Rate: repeats every 271 hours.
.4 Mounting: Integrated within Digital Signal Processing

2.8 SYSTEM INPUTS

.1 PA: 3-pin phoenix connector at over 2K Ohm Microphone pre-gain: 30-60dB Frequency: 80Hz – 18kHz
.2 Background Music: RCA terminations at over 10K Ohm Frequency: 50Hz – 20 kHz
.3 Audio – 2 Channels

2.9 EQUALIZER FILTERS

.1 Requirement on each output channel with control over 31 - 1/3 octave bands on each channel.
.2 Integrated within Digital Signal Processing unit.
.3 Equalization: 1/3 octave using ISO standard frequencies from 63-12,500 Hz minimum.
.4 Output: 600 ohms balanced and adjustable.
.5 Filters: adjustable minimum 20 dB adjustment per band.
.6 Level Tolerance: +/- 1 dB from 200-4000 Hz.
.7 Total Harmonic Distortion: less than 0.5% at full rated output.
.8 Equivalent Input Noise: less than –85 dBA from 20-20,000 Hz unweighted.
.9 Output: transformer isolated.
.10 Front panel security cover.
.11 Mounting: Integrated in self contained unit to be mounted in 1 RU chassis.

2.10 AMPLIFIERS

.1 2 Channel, CLASS D solid state, EIA rated
.2 Audio power handling: continuous for speaker load plus minimum 3 dB margin (single or multi-channel).
.3 Frequency response +/- 0.3 dB 20Hz – 20kHz at 100 Ohm.
.4 Total Harmonic Distortion: less than 1% at 1kHz at rated output.
.5 Transformer Output: 70.7volt line and audio line level.
.6 Automatic and manual gain control adjustable to 34 dB.
.7 Output Regulation within 2dB, from no load to full load.
.8 Power Supply: self-contained and CSA approved.
.9 Mounting: Integrated in self contained unit to be mounted in 1RU chassis.
.10 Input impedance: 50K Ohm.
.11 Output impedance: 0.08 Ohm.
.12 Carrier Frequency: 400kHz.
.13 Constant voltage at 25W
.14 +/- 15VDC and 100kHz square sine wave.
.15 Peak current: 1.2 Amps.

2.11 MATERIALS

.1 All electronic components shall be ROHS and UL recognized.
.2 All plastics shall meet UL94VO flammability rating.
.3 Cold roll steel - 18 AWG - .047” nominal.
.4 Black powder coat paint.
.5 Corrosion resistant.
.6 White silk screen on rear.

.7 Molex front cover.

2.12 SCHEDULER: PROGRAMMABLE TIMER

.1 Adjusts masking volume levels according to a calendar-based, programmed schedule with automatic adjustment of Daylight Savings Time.
.2 Assigns schedules to each specified zone.
.3 Offers a programmed acclimatization process with independent schedules for each timer zone.
.4 Allows for independent timer schedules for each day of the week.

2.13 ACCEPTABLE MATERIALS

.1 Subject to compliance with requirements, products that may be incorporated into the Work include:
  .1 SoundMaskIt Digital Centralized Sound Masking Systems as designed by Vibra-Sonic Control and Materials Handling Inc. Vancouver - (604) 294-9495 fax - (604) 294-8033 Calgary - (403) 217-3555 fax - (403) 237-5064

3 Execution

3.1 INSTALLATION

.1 Install system components above suspended ceiling in accordance with manufacturer's instructions and in a manner that will permit specified acoustical performance requirements will be met.
.2 Suspend sound masking units with mounting brackets/chain securely anchored to underside of structure. Ensure that there is no strain on any electrical wiring. Avoid mounting that could result in generation of vibration noise or distortion.
.3 Mount closed enclosure to radiate sound upward (unless otherwise specified).
.4 Install centralized Digital Signal Processors securely inside equipment cabinet(s) / client’s rack or on to the wall using supplied mounting hardware. Locate equipment cabinet at location directed by the consultant.
.5 Ground audio system to building power supply ground.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer’s nameplates, CSA labels and identifications nameplates are visible and legible after equipment is installed.

3.3 INSTALLATION, CABLE

.1 Avoid damage to cables. Provide adequate cable strain relief.
.2 Run cables parallel and perpendicular to building lines. Attach wiring to top of structural elements in a non-obstructive fashion. Secure every 2 meters and at changes in direction.
.3 Connect each speaker wire pair to one terminal pair on screw terminal blocks at centralized cabinet equipment.

3.4 LOCATION OF OUTLETS

.1 Indicated within Installation Information.

3.5 MOUNTING HEIGHTS

.1 Indicated within Installation Information.

3.6 TESTING, ADJUSTING AND BALANCING

.1 Calibrate the microphone and related test equipment prior to testing.

.2 Test, adjust, and balance system with mechanical system and other noise generating equipment shut down in areas receiving sound masking.
.3 Test, adjust, and balance system until sound spectrum and levels meet specified performance requirements. Adjust settings of installed units, relocate installed units, or add additional units, if and as required.
.4 Upon completion of tests, perform walk-through verification of areas that will be covered by sound masking. Adjust and re-test areas having abnormal characteristics or levels.

3.7 TESTS AND TEST METHODS

.1 Test to determine each zone’s octave band sound pressure levels. Take a series of readings for unit coverage area.
.2 Test to determine spatial average overall sound pressure levels. Take minimum of one reading for each enclosed room covered by sound masking and minimum of one reading per 20 m2 (215 ft2) of floor area in all open spaces covered by sound masking.
.3 Position of Measuring Microphone: 1220 mm (48”) above floor and minimum 1000 mm (40”) away from any sound reflecting surface, in locations representative of each area that are sound masked.

3.8 MEASURE SOUND PRESSURE LEVELS USING ONE OF FOLLOWING METHODS

.1 An Equivalent Continuous Sound Level (LEQ) mode for minimum interval of 15 seconds.
.2 IEC 651 'slow' time constant, average reading of the highest and lowest level during 15 second intervals.

3.9 TEST EQUIPMENT

.1 Sound Level Meter: to ANSI S1.4-1983, Type 1 or better.
.2 Octave Band Filter: to ANSI S1.11, Class II or better.
.3 Accuracy of Acoustic Calibrator: within ±0.3 dB at 25°C.

END OF SECTION

1 General

1.1 REFERENCES

.1 Underwriter's Laboratories UL-1069, Standard for Hospital Signaling and Nurse Call Equipment.

.2 Canadian Standards Association.

.1 CSA 22.1-21; Canadian Electrical Code, 25th Edition.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

.2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.3 SYSTEM DESCRIPTION

.1 Install new Nurse Call System throughout the new QEH Mental Health Addition and interface the new system, back to the new hospital wide Nurse Call System which will be installed throughout the Hospital in the Fall of 2022, as a replacement to the existing Rauland System.

.2 Where specifics of the new hospital wide Nurse Call System will not be known utnil this project is under construction, the specific devices, interconnections and tie-ins between this project's Nurse Call System and the new hospital wide Nurse Call Systenm will until the Summer of 2022.

.3 System hardware is to consist of a nurse/patient communications network comprised of nurse consoles, control stations, dome lights, call cords, pull cord stations, emergency push button stations, wiring and other options, as shown on drawings and specified herein. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, is to be supplied and installed to provide a complete and operating nurse/patient communications network.

.4 The system is to be compatible with the new Hospital Wide Nurse Call Systems, allowing calls from the system to appear and go into audio communication from the common consoles, staff terminals, duty stations, zone lights and PC displays as well as allow patient to staff assignment via a common client application. Specifics regarding the new hospital wide Nurse Call System to be provided when known in the Summer of 2022.

.5 Contractor is to carry a cash allowance for all material, labour and plant associated with the installation, programming and verification of this new Nurse Call System as indicated on the Bid Form (Section 00 41 13 - Bid Form).

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements. Once new hosptial wide Nurse Call System is made known.

.2 Include all relevant schematic, wiring and interconnection diagrams.

1.5 WARRANTY

.1 Provide a warranty on the system which includes all necessary labor and equipment to maintain the new system(s) in full operation for a period of one (1) year from the date of acceptance.

.2 Provide all necessary product firmware/software upgrades throughout the warranty period.

.3 Provide warranty for all core system components including control/switching equipment, power supplies, patient stations, sub-stations, and nurse consoles for a total of five (5) years.

.4 After the acceptance of the system(s), service is to be provided on the following basis:

.1 Emergency Service - Provide 24 hours a day. When a total or catastrophic failure of equipment is reported to Contractor, within two (2) hours of notification, a service person is to be on site. (An example of a catastrophic failure would be a hub failure or a nurse console failure).

.2 Routine Service - Provide when a minor failure of equipment is reported to Contractor, a service person will be on site within 24 hours of notification. (An example of a minor failure includes peripheral equipment such as control stations, corridor lights, pull-cord stations, etc. which normally affect only one patient or patient room.)

2 Products

2.1 MANUFACTURERS

.1 The products specified are to be new, free from blemish by a single manufacturer.

.2 Acceptable Material:

.1 To match new hospital wide Nurse Call System.

2.2 NURSE CALL CONTROLLER(S)

.1 Furnish as needed in each nursing unit a nurse call network controller. Each controller is to provide the following:

.1 Non-blocking, duplex communications between consoles and rooms, and sub stations, within each 6 station loop. Provide four (4) loops for a total of twelve (12) dynamically allocated speech paths.

.2 CAT 6 wiring standard utilizing PoE (Power over Ethernet) between console and nurse call controllers and local wiring to power room station equipment and dome lights.

.3 VoIP audio to Nurse Call Network, VoIP Nurse Console, VoIP staff terminal, wired or wireless phones via SIP protocol. VoIP digital audio stream out to rooms with IP overhead signaling.

.4 Up to ninety-six (96) corridor lights or domeless controllers can be operated with a single controller.

.2 Controller to be life safety grade, meaning that it does not require regular rebooting for continued basic functions of system and it is to be possible for the controller to act as a stand alone controller, should loss of network communication occur. Personal computers may not be used for this purpose. PCs will only be allowed outside of the UL-listed nurse call network on the customer supported LAN.

.3 Nurse call controller(s) are connected to the hospital's LAN via Ethernet switches. The nurse call servers also connected to the hospital's LAN are running specialized software for using hospital data resources and telephone communications resources.

.4 Acceptable Materials:

.1 To match new hospital wide Nurse Call System.

2.3 VOIP NURSE CONSOLES

.1 Furnish as shown on plans, a UL-1069 listed VoIP nurse console capable of the following functions:

.1 Full duplex audio

.2 Color Display

.3 12 or 24 hours time display and synchronization to hospital standard network time from the nurse call gateway server including any daylight savings time changes supported by the network.

.4 Display up to 3 incoming calls each with an individual elapsed timer which increments time since call was placed. Also provide the ability to scroll to see more incoming calls.

.5 Power over Ethernet powered connection to UL-1069 listed Ethernet controller. No local power supplies required.
.6 Choice of hands-free duplex communications through built in speaker and separate microphone or private handset conversation.
.7 Ability to create up to 32 soft keys, user-configurable, with 4 buttons, 8 screens deep.
.8 Console to be interactive with an associated PC workstation (user provided) without the necessity of any interconnection to the PC. The work process relationship is to be software defined through the network connections.
.9 Optional tone/mute of calls in progress.
.10 Ability to block all nurse call loudspeaker paging to facilitate a low noise patient environment. Password protection can be enabled to only allow authorized access to audio paging.
.11 Ability to swing an individual room or any group of rooms by touching one labeled touch point. Room(s) and consoles may be located anywhere within hospital nurse/patient communications network.
.12 Console can be programmed to be the receiver of any call that is not answered by another console, or can be programmed to receive any call from a console that has failed or has been unplugged, or otherwise not receiving the call (call orphaning).
.13 Ability to dial through built in key pad.
.14 Self-contained unit which is desk mountable.
.15 Acceptable Materials:
.1 To match new hospital wide Nurse Call System.

2.4 STAFF CONTROL STATION

.1 Staff Control Station is to provide two-way hands free duplex intercom to its assigned nurse console(s) by pushing a call in button. Unit is to mount in a standard single gang electrical box.
.2 Acceptable Materials:
.1 To match new hospital wide Nurse Call System.

2.5 DUTY CONTROL STATION

.1 Duty Control Station is to provide remote annunciation of assigned patient stations and sub-stations via 4 LED's and multiple call tones. Duty station faceplate LED's are to mimic corridor light activity for the assigned nursing area. Unit to also provide two-way duplex intercom to the assigned nurse console(s) through separate speaker and microphone. Call tones generated at duty station must be identical and repeat in sync with tones produced at closest nurse console. Unit to be capable of muting the call-in tone, without cancelling the call. The next call in, assigned to this duty station, will un-mute the station. The duty station is to be capable of being programmed for a specific time that a day/night mode takes place, allowing a volume change to the call-in tones. This feature is required to minimize noise for patients. Unit is to mount in a standard single gang electrical box.
.2 Acceptable Materials:
.1 To match new hospital wide Nurse Call System.

2.6 SUB-STATIONS

.1 Sub-Stations to be flush mounted in a single gang electrical box. All sub station cancel buttons will follow the cancel policy as defined in the system configuration. Typically canceling a high priority call can only be accomplished by the station initiating a call, while lower priority calls may be cancelled by any associated station in the room.
.2 Individual sub-stations are to consist of:
.1 Pull Cord Station: water resistant with a replaceable PVC pull-cord, and easily cleaned surface. The pull-cord shall have a large, easy to pull plastic "bell" attached. This station may only be cancelable with the room and not cancelable from the nurse console.

.1 Acceptable Materials:
.1 To match new hospital wide Nurse Call System.

.2 Dual Button Stations: water resistant, with back lit buttons and have the ability for a user defined customized call label corresponding to the call priorities available within the system. An elapsed timer may be activated by any call button to start a count up timer on any clock that accepts remote activation.
.1 Acceptable Materials:
.1 To match new hospital wide Nurse Call System.

2.7 CORRIDOR LIGHTS AND DOMELESS CONTROLLERS

.1 Corridor lights are to contain four sections, each lighted by a long life, RGB LED capable of producing 7 colors. Each section is to have a diffusion lens which allows for 180 degree horizontal visibility of call lights. The corridor lights shall be capable of the following:
.1 All segments of corridor light can indicate a call in any of the following 7 colors: Blue, Red, White, Green, Orange, Yellow, or Pink.
.2 Custom call patterns (any combination of light segments, such as all segments blue for code blue).
.3 Flash any single color or strobe the sections of the light in any color pattern.

.2 Intelligence in the corridor light or domeless controller is to support up to 16 room devices and allow for the ability of any room station to be associated with any other room in the system. This allows special functions where needed, such as associated call stations and cancelling options (i.e. door monitoring).

.3 Staff registration is to be indicated by a custom color associated with that staff level (i.e. Green = Nurse, Orange = LPN, Yellow = Aide).

.4 Domeless controllers are to have all the function of the corridor light, less indication LED's.

.5 In the event of communications loss with the nurse call controller, corridor lights and domeless controllers are to enter a local room failsafe mode showing all calls in the hallway via the LED indicators.

.6 Corridor lights and domeless controllers may be hot-swapped on the room-to-room communication line without the loss of communications to other devices on the local network.

.7 Acceptable Materials:
.1 To match new hospital wide Nurse Call System.

2.8 SYSTEM DIAGNOSTICS

.1 All components in the system are to be continuously supervised for both power and data to ensure proper operation and in the case of system faults to aid in troubleshooting.

.2 Capability for any designated network data interface location, on or off site, to diagnose all network active components, hub controllers, control stations, and sub-station operation. Network administrator is to be able to:
.1 Review system faults reported (i.e. control station, sub-station failure).
.2 Place control station or network interface devices into interrogation mode for the purpose of running a diagnostic check of electronic components.

.3 Hub controller to report faults or failure of assigned control, or network interface devices in plain English to its designated nurse consoles.

2.9 REPORTING SOFTWARE

.1 Provide software that may be accessed by any networked PC work station that gives management patient call details in clear readable format. Software is to make all pertinent patient details available, including the ability to search by patient name and/or patient ID number for those nurse call records associated for that patient during their stay, regardless of room/bed occupied. All reports are to be itemized in a historical log.

.2 Reporting software is to provide the following functions:
.1 Standard, global reports.
.2 Summary reports.

.3 Detailed reports.
.4 Graphic reports.
.5 Productivity reports.
.6 Staff coverage reports.
.7 Reports are to be viewed in Adobe Acrobat Reader.
.8 Does not require additional off-the-shelf software for the generation of reports.

3 Execution

3.1 COMMISSIONING

.1 Provide for Manufacturer's certified service technician to install, program and commission the new and / or modified Nurse Call system.

3.2 TRAINING

.1 Provide thorough training by Manufacturer's certified technician, to all nursing staff assigned to those nursing units affected by the installation of new or modified of new networked nurse/patient communications equipment. This training is to be developed and implemented for as long as required to ensure of staff are comfortable and fully understand how to use the new or modified Nurse / Patient Communications equipment.

3.3 WIRING

.1 Contractor is to terminate all wiring with manufacturer approved connectors. The use of wire nuts is prohibited.
.2 All Nurse Call wiring is to be installed in accordance with the manufacturers wiring instructions and be free from shorts and faults.
.3 Nurse patient communications network wiring is to be installed in a separate conduit, in accordance with Specification Section 26 05 34 - Conduits, Conduit Fastening and Conduit Fittings.

3.4 ELECTRICAL POWER CONNECTIONS

.1 Provide a dedicated 120 VAC, 60 HZ conduit feed into the equipment cabinet. This power feed is to not have any other devices connected directly to it. A 15 AMP circuit breaker located in the electrical sub-panel labeled "nurse call" will control the circuit. This electrical circuit will be connected to the hospitals emergency power system for automatic power switch over during loss of utility power.
.2 Connect all network system power supplies and equipment cabinets to a common earth ground utilizing a 14 AWG, or larger, solid conductor which is at minimum the same conductor size as the AC feed wires.

3.5 ENVIRONMENTAL PROTECTION

.1 Make certain that all network hub control equipment is accessible for service. Contractor to notify Consultant if designated equipment closet does not meet manufacturer's requirements for heat, radiation or static electricity.

3.6 PROTECTION OF NETWORK DEVICES

.1 Contractor to protect network devices during unpacking and installation by wearing manufacturer approved ESD wrist straps tied to chassis ground. The wrist strap is to meet Occupational Health and Safety for prevention of electrical shock, should technician come in contact with high voltage.

3.7 CLEANING AND PATCHING

.1 Keep work area clear of debris and clean the work area daily at the completion of work.
.2 Patch and paint any wall or surface that has been disturbed by the execution of this work.

3.8 RECORD DRAWINGS

.1 Provide as-built drawings of all installed network components and associated wiring on building plans, in accordance with Division 01 - General Conditions.

3.9 FIELD QUALITY CONTROL

.1 Perform tests and provide verification reports in accordance with Section 26 05 00 - Common Work Results - Electrical.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.
.2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 DESCRIPTION OF SYSTEM

.1 Complete system of conduit raceways, outlet boxes, outlet assemblies, coverplates, splitters and coaxial cable as described herein.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

1.4 QUALITY ASSURANCE

.1 All cabling, terminations, hardware and connectors etc., to be sourced from a certifying manufacturer to assure quality control.

1.5 WARRANTY

.1 Ensure equipment installed is warranted by the manufacturer to be free of defects in operation, material and workmanship for a period of one (1) year from the date of Substantial Completion.

2 Products

2.1 OUTLETS

.1 Outlets complete with one (1) single G/F connector mounted in stainless steel wall plate.
.2 Acceptable material:
  .1 Blonder Tongue #TF-GF-FT.
  .2 Pass & Seymour.
  .3 Leviton.
  .4 Hubbell.

2.2 DISTRIBUTION SPLITTERS

.1 Wall mount die cast housing, with built-in ground block, performance rated to 1000 MHz: multiple taps, number of taps as indicated and attenuation rating to suit application.
.2 Acceptable material:
  .1 Blonder Tongue #SXRS series.
  .2 Toner.
  .3 Lindsay.

2.3 COAXIAL CABLE

.1 Coaxial cable: 75 ohm, FT4 rated, RG-6 type, black jacket, inner polyethylene foam insulator and outer aluminum braid and foil.
.2 Acceptable material:
  .1 Commscope #5730.
  .2 Belden 1829A.

2.4 CABLE SUPPORT

.1 Provide support for coaxial cables in accordance with Section 27 05 28 - Pathways for Communications Systems.

3 Execution

3.1 INSTALLATION

.1 Install conduit raceways and J-hooks supports, as indicated.
.2 Install one run of cable from each outlet to splitters as indicated.
.3 Run distribution cables from splitter locations to TV.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 08 71 00 - Door Hardware.
.2 Section 26 05 00 - Common Work Results - Electrical
.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE STANDARDS

.1 National Fire Protection Association (NFPA)
  .1 NFPA 71- Standard from the Installation, Maintenance and Use of Signaling Systems for Central Station Services.
.2 Underwriter's Laboratories Canada (ULC)
  .1 CAN/ULC S304, Standard for control and monitoring station burglar alarm units.

1.3 DESCRIPTION OF SYSTEM

.1 Provide a complete access control system to continuously monitor and control access to the renovated area, as indicated.
.2 Provide the necessary hardware to communicate with the hospitals existing access control network. No additonal user licenses are required for this addition.
.3 Access control system to consist of but is not limited to, door control panels, proximity card readers, credentials, manrual control stations, request-to-exit motion detector and associated conduit and wiring.
.4 Door hardware including electric strikes, door power supplies, door contacts, electro magnetic locks, electrified hinges, sensor bars and electrified hardware is to be supplied and installed by Division 08. Refer to Section 08 71 00 and associated door hardware schedule for detailed information.
.5 Commission and provide programming of the system in accordance with the Hospital's security and access control requirements.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
  .1 Include wiring diagrams and riser schematics indicating location of controllers and devices and terminal splice boxes.

1.5 WARRANTY

.1 Submit manufacturer's warranty document executed by an authorized company or official stating that the access control system is warranted against defects in operation, material and workmanship for a period of one (1) year from date of signed off substantial completion. Include system warranty document in Maintenance Manuals.

2 Products

2.1 DOOR CONTROLLER

.1 Each door controller to be capable of interfacing with peripheral access control and other door controllers as indicated.
.2 Four (4) monitored NO or NC dry contacts, with a minimum of four (4) Class 2 control relay outputs rated 2A at 30 VDC.
.3 Network interface to existing door controllers.
.4 Integral 12 V / 18 V, 70 VA transformer with 12 V, 7 Ah supervised battery backup.
.5 Lockable CSA type 1 enclosure c/w tamper switch.
.6 Programmable input expansion module to monitor devices.

.7 12 V, 1A supervised door power output.
.8 Acceptable material (to match existing):
.1 Axiom #RC-2 and RBH #UNC500.

2.2 DOOR CONTACTS

.1 Recess mounted in door frame for detection when door is open.
.2 Magnetic type, 30 VDC, 3 W max, double pole type.
.3 Tamper switch.
.4 Suplied by Division 08, installed and wired by Division 28.

2.3 REQUEST-TO-EXIT MOTION DETECTORS

.1 Passive infrared technology with aimable detection to shunt the door contact alarm input and allow free exit. Detector is to not directly unlock the door.
.2 Detector to have a white high impact plastic housing c/w internal buzzer that sounds if the door is left open.
.3 Acceptable material:
.1 Kantech #T.REX-XL.

2.4 PROXIMITY CARD READERS

.1 Impact resistant polycarbonate housing suitable for interior and exterior installations.
.2 Capable of being mounted to metal door mullions where indicated on the Drawings.
.3 Audible and visual operation through LED indicators and internal buzzer.
.4 125 kHz HiD operation capable of a 150mm read range.
.5 Acceptable material (to match existing):
.1 HID #MiniProx Series.

2.5 WIRING

.1 Wiring and cables in accordance with the recommendations of the approved system manufacturer. Access control cabling as follows:

DESCRIPTION	WIRE TYPE	PART #
Door Controller Network Cable	2 Pair #24 Shielded	Provo #5402
Door Controller Power Cable	2C#16 AWG	Provo #9162
Card Readers	6C#18 AWG Shielded	Provo #6506
Door Contacts	2C#22 AWG	Provo #9222
Electric Latch Retraction	5C#18 AWG	Provo #9185
Electric Strikes	2C#18 AWG	Provo #9182
Request-to-Exit Motion Detectors	4C#22 AWG	Provo #9184
Magnetic Locks	2C#16 AWG	Provo #9162

3 Execution

3.1 INSTALLATION

.1 Install all wiring, raceway, outlet boxes, panels and devices including any miscellaneous material to constitute complete system as indicated.
.2 Install conduit from access control devices located in walls and door frames to door control panel location, without splices where possible. Where splicing or junctions are required on access control cabling, use dedicated juction boxes with clearly identified adn accessible terminal strips. Wire nuts will not be permitted. Rough-in device boxes for card readers and access control devices as required.

.3 All access control cabling is to be installed in conduit in accordance with Specification Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. Conceal conduit in inconspicuous but accessible locations.
.4 Supply and install access control cabling from field mounted devices to door control panels.
.5 Terminate access control cabling on field mounted devices in accordance with manufacturer's instructions.
.6 Supply and install network cable interconnecting all door control panels in accordance with manufacturer's instructions.
.7 Exact location of door controllers with accessible ceiling space of corridor to be cooridnated onsite with the General Contractor, other Trades and Owner's Representative, prior to rough-in. Door controllers are to be readily accessible from a step ladder.
.8 Label each door controller with a Size 2 lamicoid nameplate in accordance with Section 26 50 00 - Common Work Results - Electrical.
.9 Add access control cabling is to be installed in conduit: free air cabling will not be permitted.

3.2 VERIFICATION AND COMMISSIONING

.1 Arrange and include an 8-hour site visit by the Manufacturer's Technical Representative to verify, commission, program the system and demonstrate the operation of the system to the Hospital Maintenance Staff. Provide manufacturer's verification certificate in the Maintenance Manuals. Verification to include but is not limited to:
  .1 Compliance with manufacturer's specification, product literature and installation instructions.
  .2 Operation of each device individually and within its environment.
  .3 Operation of each device in relation with programmable schedule and or/specific functions.
.2 Coordinate with Owner's Representative to determine exact system requirements such as scheduling, zone identification, etc., and program system to the Hospital's specific requirements.

3.3 CLEANING AND ADJUSTING

.1 Remove protective coverings from control panels, detection accessories and components.
.2 Adjust all components for correct function.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.
.2 Section 27 10 05 - Structured Cabling for Communication Systems.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)
  .1 CSA C22.1-21, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.
.2 Underwriters Laboratories of Canada (ULC)
  .1 ULC-S317, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 DESIGN PERFORMANCE REQUIREMENTS

.1 Provision to switch to and monitor any camera in system manually or automatically on a pre-programmed schedule.
.2 Enter and edit surveillance programs and save them for future use.
.3 Set dwell time for viewing of any camera picture.
.4 Define sequence for viewing cameras.
.5 Bypass cameras in system during sequencing to monitor.
.6 Provide ability to display stored or real-time camera image at a local station or remotely over the dedicated CCTV network.
.7 Overall control of surveillance system provided through software control, which provides complete integration of all components.
.8 Integreted NVR and PoE switch configuration, size and capacity as indicated.
.9 PoE cameral network to be fully independent from the ITSS communication network.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
.2 Shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme including:
  .1 Functional description of equipment.
  .2 Technical data sheets of all devices.
  .3 Device location plans and cable lists.
  .4 Video camera surveillance chart.
.3 Maintenance Data: Submit maintenance data for incorporation into manual specified in Division 01 - General Requirements - Closeout Submittals. Include following:
  .1 Instructions on operation, adjustment and cleaning.
  .2 Illustrations and diagrams to supplement procedures.
  .3 Manufacturer's operation and maintenance instructions.

1.5 WARRANTY

.1 Manufacturer's Warranty: Submit, for Owner’s Representative's acceptance, manufacturer's warranty document executed by authorized company official, stating that the video surveillance system is warranted against defects in operation, material and workmanship for a period of 12 months from the date of substantial completion of the project.

2 Products

2.1 MATERIALS

.1 PoE Network Camera:
- .1 Minimum light intensity:
  - .1 0.25 lux, (colour); 0.05 lux (B/W).
- .2 Resolution: Minimum of 5 variable settings with a minimum resolution of 2592 x 1944, selectable frame rate with 60 fps max. 5 MP for indoor cameras and 8 MP for outdoor cameras.
- .3 Lens:
  - .1 Exterior: f/1.8, 90°(H) x 60°(V) wide angle.
  - .2 Interior: f/1.8, 55°(H) x 41°(V) (or wide angle as required to achieve best coverage).
- .4 Mounting: Pendant. Provide gooseneck mount installation brackets for exterior facade mounted cameras.
- .5 Supported protocols: TCP/IP, UDP, ICMP, IPv4, SNMP, HTTP, HTTPS, SSL, SSH, SMTP, FTP, RTSP, UPnP, DNS, NTP, RTP, RTCP.
- .6 Operational voltage: PoE (IEEE802.3af, class 3); 24 VAC nominal; 18 to 32 VAC range.
- .7 Power consumption: less than 8 W nominal.
- .8 Environment: Camera components and systems to operate with all specified requirements under following ambient temperatures:
  - .1 Outdoor installations:
    - .1 Temperature: -40°C to 50°C
    - .2 Humidity: 15 to 85%
- .9 Camera Housings:
  - .1 Exterior: Equipped with IP 66 weather tight back box and enclosure.
  - .2 Interior: Impact resistant and anit-ligature rated camera where indicated on the Drawings.
- .10 Transmission Methods: CAT 6 cable or better and RJ-45 network port.
- .11 Configurable frame rates and bit rates for bandwidth administration.
- .12 Capable of backing up and restoring factory or user defined camera settings through embedded software.
- .13 Acceptable material:
  - .1 Avigilon.
  - .2 Hikvision .
  - .3 Axis Communication.
  - .4 Panasonic.

.2 Storage
- .1 Network Video Recorder / Network Attached Storage (NAS) Server
  - .1 Support recording of JPEG, MPEG-4, H.264 and other compatible IP streams.
  - .2 Minimum total system storage of 16TB harddrives, two gigabit Ethernet RJ-45 ports, one for camera data and one for network connection, rack mountable chassis. 24-port intergrated and manage PoE switch.

.3 IP Video Management Software
- .1 Capable of running client applications as well as video management system.
- .2 A remote client computer with system compatible software will be the interface for viewing and control of the system. Non-expiring software licenses to be purchased by the Client in quantities as required.
- .3 Software functions are to include but not be limited to, screen layout selection, time and date search, control, video stream modification for bandwidth administration, and on-the-fly changes such as frame rate, frame size.

.4 Include non-expiring camera licenses as required to accommodate all IP cameras for a complete system as indicated.
.5 Remote client PC's to be supplied and installed by others. PC to accommodate video management software requirements.

3 Execution

3.1 INSTALLATION

.1 Supply and install video surveillance equipment and components in accordance with ULC-S317.
.2 Supply and install all required cabling, patch cords, boxes, mounting hardware, brackets, cameras and system components as required for a fully functional video surveillance system in accordance with manufacturer's written installation instructions.
.3 CCTV NVR to be racked mounted in new data rack located in LAN Room #1743A. Coordinate installation with ITSS and provide 1m service loop of cable at Data Rack.
.4 Coordinate with Departmental Representative and ITSS, the exact IP segement to assing new CCTV cameras.
.5 Supply and install components secure, properly aligned and in locations shown on reviewed shop drawings.
.6 Connect network camera system distribution equipment and cabling in accordance with Specification Section 27 10 05 - Structured Cabling for Communication Systems, and manufacturer's wiring and installation instructions.
.7 Jacket color and MDVO outlet for all CCTV communications cabling to be purple.

3.2 FIELD QUALITY CONTROL

.1 Manufacturer's Services:
  .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  .2 Provide for manufacturer's certified technician to visit, program, commission, and verify complete camera system and software. Schedule and provide for a system configuration and software/hardware training session given by the manufacturer's certified technician to the Client. System software to be configured to the specific Client requests.

3.3 CLEANING AND ADJUSTING

.1 Remove protective coverings from cameras and components.
.2 Adjust cameras for correct function.
.3 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION

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1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 SUMMARY

.1 Section Includes:
- .1 Materials and installation for additions to the existing fire alarm systems.
- .2 Manual alarm stations.
- .3 Automatic alarm initiating devices.
- .4 Audible signal devices.
- .5 Fire alarm booster panels.
- .6 Aspirating devices.
- .7 End-of-line devices.
- .8 Fault isolators.
- .9 System operation.
- .10 Verification.

.2 General Requirements
- .1 This specification details modifications and additions required to the existing fire alarm addressable initiation and notification system located at the Queen Elizabeth Hospital in Charlottetown, PE.
- .2 The manufacturer is required to identify any areas of the specification where they do not completely comply.
- .3 Modifications and additions to the existing fire alarm system must include all the necessary electronic hardware, software, and memory for a completely operable system in accordance with these specifications and associated drawings as required, to perform the functions described herein.
- .4 Device and equipment locations are approximate only and must be field verified prior to tendering and the tender price adjusted to cover actual conditions.
- .5 Install all new wire, conduit, and fire alarm devices in accordance with the drawings and specifications. The actual device, equipment, and wiring layout will be the manufacturer's responsibility and detailed wiring and installation drawings must be provided.
- .6 The exact location of capacity of existing initiation and notification loops is to be verified on site. Any modifications required to existing initiation and notification loop required for a full functional system as described is to be carried in the tender price.

1.3 REFERENCES

.1 Government of Canada
- .1 NBC-2015 National Building Code of Canada.
- .2 NFC-2012 National Fire Code of Canada.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

.3 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
- .2 CAN/ULC-S525, Audible Signal Device for Fire Alarm Systems.
- .3 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems.
- .4 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
- .5 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
- .6 CAN/ULC-S537, Verification of Fire Alarm Systems.
- .7 ULC-S548-08, Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems.

.4 National Fire Protection Agency (NFPA)

.1 NFPA 72, National Fire Alarm Code.
.2 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
.3 NFPA 101, Life Safety Code.

.5 International Standard Organization (ISO)
.1 ISO 8201, Acoustics - Audible Emergency Evacuation Signal.

1.4 SHOP DRAWINGS

.1 Shop Drawings:
.1 Submit shop drawings and product data for all fire alarm equipment and devices in accordance with Division 01 - General Requirements.
.1 All fire alarm equipment and devices.
.2 Include:
.1 Layout of equipment.
.2 Zoning.
.3 Complete wiring diagram, including schematics of modules.
.3 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.
.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions.
.3 Manufacturer's Field Reports: manufacturer's field reports specified.
.4 Closeout Submittals:
.1 System wiring diagrams:
.2 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
.3 Power Calculations:
.1 Submit design calculations for new work specified to substantiate that battery capacity for each new or modified circuit exceeds supervisory and alarm power requirements by 25%.
.2 Show comparison of detector power requirements per zone versus control panel fire detector power output per zone in both standby and alarm modes for zones affected by the renovations.
.3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output for notification circuits affected by the renovations.

1.5 QUALITY ASSURANCE

.1 Qualifications:
.1 Installer: company or person specializing in fire alarm system installations with five (5) years documented experience approved by manufacturer.
.2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
.3 System:
.1 In accordance with applicable Codes, Standards and the Authority Having Jurisdiction.
.4 Inspection and verification of the modified fire alarm system to conform to CAN/ULC-S536 and CAN/ULC-S561. Submit verification report to Consultant.

2 Products

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
.2 Audible signal devices: to CAN/ULC-S525.
.3 Manual pull stations: to CAN/ULC-S528.
.4 Smoke detectors: to CAN/ULC-S529.

2.2 DESCRIPTION OF WORK

.1 This specification details Modifications and additions to the existing fire alarm initiation and notification system at the Queen Elizabeth Hospital, in Charlottetown, PEI.
.2 Installation, commissioning and verification of new and modified fire alarm system devices and wiring.
.3 The existing networked fire alarm control system is to be reused, along with all the existing fire alarm protection functions including receiving alarm signals, initiating general alarms, supervising the system continuously, actuating zone annunciators, and initiating trouble signals unless otherwise indicated.
.4 The existing fire alarm control panel is a Siemens MXL-IQ series panel, which is located Data Room #72003 (and networked FACP in Electrical Room #1853).
.5 Installation to proceed on the basis that the building is fully occupied and retrofit of the existing fire alarm system will be implemented in a manner to minimize disruption of day-to-day operations and personnel within the building.
.6 During the retrofit, fire protection must be maintained throughout all areas of the building, and is to conform to the following standard: NFPA 101: 9.6.1.7 - Fire Alarm System Shutdown which states: "Where a required fire alarm system is out of service for more than 4 hours in a 24-hour period, the authority having jurisdiction is to be notified and the building must be evacuated or an approved fire watch must be provided for all parties left unprotected by the shutdown until the fire alarm system has been returned to service." As the building cannot be evacuated the Contractor must provide an approved fire watch when necessary and the fire watch must be provided using security cleared and qualified personnel. When necessary, the Contractor is to carry the full cost for fire watch in the tender price.
.7 Install temporary covers on existing spot type fire alarm detectors to prevent false alarms during supervised work.

2.3 SYSTEM OPERATION

.1 Actuation of any second stage alarm to:
  .1 Indicate type of alarm and location at control panels and remote annunciators.
  .2 Cause audible signalling devices to sound throughout the building and at the control panel.
  .3 Cause visual signals to flash self-synchronizing strobes continuously throughout the building.
    .1 Where new devices are installed on existing notification loops, synchronizing devices are to be provided or additional conductors connected to provide synchronized notification throughout the visible area in accordance with CAN/ULC-S524 Article 5.4.5.2.
  .4 Transmit signal to fire receiving centre via central station and signal transmitting unit.
  .5 Cause AHU-12 to shut down. Existing equipment shutdown and control sequencing to otherwise be maintained.
  .6 Release fire / smoke control door hold-open devices.

.1 Safe Room 5664A and Water Closet 5664C are "contained use areas" in accordance with NBCC-2015, article 3.4.6.16 and doors will not release to permit free egress upon activation of the fire alarm system. Occupants of these spaces are to be continuously monitored and an AHJ approved operational plan is to be implemented an maintained by the Hospital Administration.

.2 Actuation of first stage alarm to:
- .1 Indicate type of supervisory device and location at control panel and where applicable, at remote annunciator.
- .2 Cause audible signal at control panel to sound.
- .3 Activate common supervisory sequence.

.3 If the first stage alarm is not acknowledged in two minutes, system to automatically go into second stage.

.4 Acknowledging alarm: indicated at control panel.

.5 Possible to silence signals by "alarm silence" switch at control unit after 60 second period of operation.

.6 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

.7 Actuation of supervisory devices to:
- .1 Indicate type of supervisory device and location at control panel and where applicable, at remote annunciator.
- .2 Cause audible signal at control panel to sound.
- .3 Activate common supervisory sequence.

.8 Resetting alarm or supervisory device not to return system indications/functions back to normal until control panel has been reset.

.9 Trouble on system to:
- .1 Indicate device and circuit in trouble at control panel .
- .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication, whereas visual indication to remain until trouble is cleared and system is back to normal.

.10 Trouble on system: suppressed during course of alarm.

.11 Trouble condition of any circuit in system not to initiate alarm conditions.

2.4 INITIATING / INPUT CIRCUITS

.1 Receiving circuits for alarm initiating devices such as manual pull stations and smoke detectors to be, wired in a Class A configuration to closest available existing initiation loop.

.2 Alarm receiving circuits: compatible with smoke detectors and open contact devices.

.3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".

.4 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

2.5 ALARM OUTPUT CIRCUITS

.1 Alarm output circuits: connected to output or notification devices, wired in Class A, configuration to the closest available existing notification loop.
- .1 Signal circuit operation to follow system programming, capable of sounding signals either continuously, at 20spm or using a temporal pattern as described by International Standard ISO 8201, Acoustics - Audible Emergency Evacuation Signal and continuously flashing visual signals. Each signal circuit rated at 6 A, 24 VDC, fuse protected from overloading/overcurrent.

2.6 WIRING

.1 Wire type and number of conductors as recommended by fire alarm equipment manufacturer.

.2 To initiating circuits: Power limited fire alarm armoured cable or in conduit, twisted or untwisted, shielded or unshielded, copper conductors #18 AWG minimum, 300 V, FT4 rated to: CSA C22.2 No. 208-03, FAS 105°C.
.3 To signal circuits: 14 AWG, RW90 minimum and in accordance with manufacturer's requirements for voltage drop.
.4 To control circuits: 14 AWG, RW90 minimum and in accordance with manufacturer's requirements.

2.7 MANUAL ALARM STATIONS

.1 Addressable manual pull station: pull lever, surface semi-flush, wall mounted type, bilingual English/French signage, and electronics to communicate station's status to addressable module. Station address to be set on station in field.
.2 Acceptable Material:
.1 Siemens #MSI-30BC (to match existing).

2.8 AUTOMATIC ALARM INITIATING DEVICES

.1 Addressable variable-sensitivity smoke detectors:
.1 Combination photoelectric rate of rise heat type.
.2 Electronics to communicate detector's status to integral addressable module.
.3 Detector address to be set on detector base in field.
.4 Sensitivity settings: Five (5) settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
.5 Ability to annunciate levels of detector contamination automatically with trouble condition at control panel.
.6 Acceptable Material:
.1 Siemens #FP-11 Series (to match existing).
.2 Addressable duct detectors:
.1 Duct detector housing to be mounted to side of ductwork and be complete with clear cover, LED indicator light, and sampling tube.
.2 Duct detector to be suitable for air velocities between 100-4000 ft / min. Provide multiple detectors on duct if air velocities exceed rating of detector.
.3 Acceptable Material:
.1 Siemens #AD2 Series (to match existing).

2.9 REMOTE POWER SUPPLY

.1 120 V, 60 Hz, 3.2 A primary, to 24 VDC across four (4) Class A or B output circuits rated at 3 A maximum for any one circuit, and 6 A total.
.2 Form-C normally closed trouble relay with fully supervised power supply, battery, and notification circuits and two fully isolated control circuits.
.3 Capable of synchronization of notification appliances.
.4 Self contained unit with lockable cabinet, powder coat finish, integral battery charger, and 7.0 AH lead acid batteries.

2.10 ASPIRATING SYSTEM

.1 Aspirating smoke detector (ASD) to incorporate dual technology blue LED and IR LED laser technologies complete with built-in algorithiums to provide immunity to false alarms.
.2 ASD controller to monitor areas by means of exposed stainless steel sampling ports located in finished ceilings and concealed I{S 25mm diameter pipe network sampling ports to be tamper proof and vandal proof resistant , and anti-ligature type.
.3 ASD controller to be located in accessible ceiling space and is to be interfaced with existing fire alarm system. Provide and program new fire alarm interface relays as required to interface a full listed ASD system.

.4 The ASD is to monitor dual flow monitoring technology through the pipe network and detection chamber, and incorporate mechanical particle separator to remove particle, less than or equal to 20 microns to mitigate false alarms.
.5 Incorporate programmable relays with latching options for the following signs:
  .1 Alert.
  .2 Action 1.
  .3 Action 2.
  .4 Fire 1.
  .5 Minor Fault.
  .6 Major Fault.
.6 Acceptable material:
  .1 VESDA.

2.11 ADDRESSABLE INTERFACE MODULES

.1 Interface modules: facilitate connection of non-addressable devices (e.g. flow switch) to control panel; provided in different types for connection to monitoring devices (e.g. flow/tamper switch) and control functions (e.g. fan shutdown, door release); communicate with control panel over (minimum number of wires) or (specified by manufacturer) or (addressable devices loop).
.2 Acceptable Material:
  .1 Siemens #TRI Series (to match existing).

2.12 AUDIBLE SIGNAL DEVICES

.1 Bells: 92dB, with back box for flush mounting, 24 VDC.
.2 Do not exceed 80% of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown in required to meet this requirement.
.3 Audible signal type to match existing audible signal type in existing Hospital.
.4 Finish appliances in red.

2.13 FAULT ISOLATORS

.1 Provide line fault isolators in detector bases or separately mounted. The isolator relay is controlled by the detector or the loop controller.
.2 The isolator operates as follows:
  .1 A short on the line causes all isolators to open within 23 msec.
  .2 At 10 msec intervals, beginning nearest the loop controller, the isolators close to provide the next isolator down the line with power.
  .3 When the isolator next to the short closes, it reopens within 10 msec.

2.14 END OF LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.15 PASSIVE GRAPHIC DISPLAY

.1 Update existing passive graphic displays on white photo bond paper in metal frame with polycarbonate or plexiglass glazing.
.2 All existing graphic displays that have been modified by the renovations are to be updated and then securely attached to the wall adjacent to the fire alarm panel and remote annunciators so as to limit the possibility of loss or damage. The labelling on the graphic must closely correspond to the displays on the fire alarm annunciator or the labels for each alarm indication. All wording shall be in English. The floor plan drawing is to indicate:
  .1 The building outline showing all exterior doors.

.2 The building's fire rated divisions, corridors, stairways and elevators.
.3 The location of, and divisions between, the fire alarm zones.
.4 The location of the main fire alarm control panels.
.5 The location of the main valve for the sprinkler system and the valve for each zone as well as any other supervised valve. Use of a legend and symbols is recommended.
.6 An accurate "You are here" indicator. Graphic display must be oriented to match the direction of the location at which it is to be posted, i.e. oriented to the direction in which the person viewing the display is facing.

.3 Electronic floor plans of the areas modified by the renovations may be obtained for production of the fire alarm graphic from the Consultant for $250.00 per drawing plus HST, to cover the costs associated with the CAD work required to prepare the drawings.

2.16 MANUFACTURER

.1 Acceptable fire alarm manufacturer and material:
.1 Siemens MXL-IQ Series (to match existing)

3 Execution

3.1 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524.
.2 For signal, alarm and ancillary devices, wire in EMT conduit with wire counts to be approved by fire alarm equipment manufacturer prior to installation. Install alarm and signal circuits in separate conduits. Surface mounted devices to be installed on matching outlet boxes recommended by manufacturer.
.3 Install addressable loops.
.4 Surface mounted fire alarm conduit or boxes located in finished areas to be painted to match the associated surface color. Coordinate exact color(s) on-site.
.5 Locate and install manual alarm stations as indicated and connect to initiation circuit loops.
.6 Locate and install detectors as indicated and connect to initiation circuit loops. Do not mount detectors in direct airflow from supply or exhaust air outlets. Maintain at least 2450mm radius clear space on ceiling, below and around detectors in accordance with CAN/ULC-S524.
.7 Connect sprinkler system alarm and supervisory switches using addressable interface modules.
.8 Provide for door release, etc. using relays and intelligent interface modules.
.9 Confirm with manufacturer if supplied interface modules require separate DC power and if so, install DC power to interface module from control panel in accordance with manufacturers wiring instructions.
.10 Install notification devices as indicated and connect to notification circuit.
.11 Install end-of-line devices as required.
.12 Coordinate with the Owner and manufacturer for the naming of all loop device locations. Provide a list to the Owner indicating all proposed naming prior to programming. Make changes as directed by Owner at no extra charge. Arrange with the manufacturer to have location names listed on charts with loop numbers and device addresses. During installation of devices, peel the serial number label from the device and stick to the location message chart beside the location name.
.13 Include system configuration and programming to meet the needs of the renovated areas and existing building designs as required. Include programming of detection devices, relays, signal devices.

3.2 FIELD QUALITY CONTROL

.1 Site Tests:
.1 Conduct tests to Section 26 05 00 - Common Work Results - Electrical and CAN/ULC-S537 for system modifications.

.2 Test each device and alarm circuit to ensure manual stations, smoke detectors and sprinkler system input signals transmit alarm to control panel and actuate general, first stage alarm and ancillary devices.
.3 Verify control or shutdown functions.
.4 Where applicable check annunciator panels to ensure zones are shown correctly.
.5 Simulate grounds and breaks on initiation and notification circuits to ensure proper operation of trouble signals.
.6 Addressable circuits system:
.1 Test each conductor.
.2 Check to ensure zones are shown correctly.
.3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of trouble signals.
.4 Verify trouble and alarm signals are received at the remote supervised location.

.2 Manufacturers Field Service:
.1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports in accordance with this Section and the Contract Documents.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits to review work in accordance with this Section and the Contract Documents.

.3 Certificates and Reports:
.1 Provide:
.1 A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
.2 A certificate of verification confirming that the inspection has been completed in accordance with CAN/ULC-S537 and CAN/ULC-S561, and showing the conditions upon which such inspection and certification have been rendered.
.3 Final test and acceptance of the system shall be witnessed by representatives of three parties: the Owner, the Contractor and the manufacturer.

3.3 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

3.4 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 WORK INCLUDED

.1 Planning and executing measures to prevent and control soil erosion.
.2 Furnishing, installing and maintaining erosion control materials.

1.2 REFERENCE STANDARDS

.1 The requirements of the P.E.I. Department of Environment and as directed on site by Consultant.

1.3 PRODUCT CONDITIONS

.1 Schedule temporary seeding, mulching and other erosion control measures to take place as soon as possible, prior to beginning any work.
.2 When temporary seeding cannot be accomplished to have established or visible growth by October 15, the disturbed areas shall be covered with 150 mm mulch for the winter.

2 Products

2.1 MATERIALS

.1 Hay Bales: Securely tied baled at least 355 mm x 460 mm x 760 mm.
.2 Geotextile fabric, including means of anchoring.
.3 Mulch Material: Select mulch material for erosion control that will best meet the site conditions from the following:
  .1 Hay or Stray- Shall be dry, free to mold and weed seeds.
  .2 Wood chips - Shall be dry, free of soil and other foreign material.
.4 Mulch Anchoring: When mulch must be held in place, one of the following mulch anchoring materials shall be used:
  .1 Mulch Netting (plastic, or plastic and wood fiber); North American Green, SC 150 or equal.
.5 Fertilizer: Complete fertilizer 10-20-20 (standard product).
.6 Lime: Ground limestone containing not less than 95% total carbonates (calcium or magnesium).
.7 Temporary Seed Mixture: as follows:
  .1 30% Regent Kentucky Bluegrass
  .2 30% Park Kentucky Bluegrass
  .3
  .4 10% Fiesta 2 Perennial Ryegrass

3 Execution

3.1 EROSION AND SEDIMENT CONTROL

.1 Provide sediment protection measures as indicated on design drawings and as specified under this Section and in accordance with PEI Department of Transportation & Infrastructure, PEI Department of Environment.
.2 Install geotextile fabric over top of new and existing catch basins to eliminate sediment from entering into sanitary or storm sewer system. Maintain as required.
.3 Install sediment control berm, silt fences and silt screens where required to prevent siltation. Construct and install silt fences as indicated just up-slope of the area to be protected in order to prevent silt from being conveyed to an adjacent property or watercourse/wetland.
.4 Maintain erosion control structures to coordinate with the schedule and sequence of the site work. Adjust erosion control structures as required.

.5 Construct and maintain ditch dams properly designed to prevent migration of silt caused by the construction activities.
.6 Maintain sediment control features throughout the construction period. Repair damage to original condition.
.7 Remove accumulated sediment from behind berm and fences as necessary. Trapped sediment shall be removed when it has accumulated to a level half the height of the fence/barrier and shall be disposed of at a location outside the buffer zone of a watercourse and such that it cannot enter a watercourse or other environmentally sensitive area.
.8 Do not remove any control features until authorized by Consultant.
.9 Remove berm and fences when reinstatement has been well established and there will be no further erosion

3.2 GENERAL CONSTRUCTION SEQUENCE TO MINIMIZE EROSION

.1 Erect hay bale dikes and/or silt fences as shown on Drawings and as may be required in the field to protect property, waterways, grassed areas, roadways, parking lots, existing features and springs.
.2 Commence excavation. Stockpile soil so that erosion is minimized. Extra precautions shall be taken when soil is saturated.
.3 Backfill excavation to grade. Grade site so that soil erosion caused by runoff will be minimized.
.4 Seed and mulch exposed ground.

3.3 SEEDING AND MULCHING

.1 All areas which will remain open shall be seeded and mulched within five (5) days of being stripped or backfilled and graded.

3.4 HAY BALES

.1 Embed hay bales into soil and anchor in place with stakes as shown on the drawings. Butt hay bales together tightly.
.2 Hay bales shall be replaced when they become clogged with soil particles or as directed by the Consultant.

3.5 DAMAGE AND REPAIR

.1 Repair all damages caused by soil erosion or construction equipment at or before the end of each working day.

END OF SECTION

1 General

1.1 SCOPE OF WORK

.1 The work of this Section comprises the furnishing of all equipment, labour and materials necessary for the excavation, trenching and backfilling, as specified in this Section and indicated on the drawings, which includes, but is NOT necessarily limited to:

- .1 Building:
  - .1 All excavation, as required, through compacted structural fill and/or undisturbed in-situ material for building foundations, including all related backfilling and compaction.
  - .2 Supply and installation of all structural fill, vapour barrier and granular base for concrete floor slab.
  - .3 Supply and installation of both vertical and/or horizontal perimeter insulation.
  - .4 All excavation, trenching, bedding, backfilling and compaction required for the work of Mechanical, Sprinkler and Electrical Divisions inside the building.
  - .5 Contractor to provide a 100mm of crushed stone above the structural fill as a working surface to facilitate the formwork for the structural slab.
- .2 Outside of building:
  - .1 All excavation, as required, through compacted structural fill and/or undisturbed in-situ material for concrete aprons, including all related backfilling and compaction.
  - .2 Supply and installation of all structural fill, polyethylene vapour barrier and granular base for concrete aprons.
  - .3 All excavation, trenching, bedding, backfilling and compaction required for the work of Mechanical, Sprinkler and Electrical Divisions outside the building.
  - .4 All areas under sidewalks, aprons, slabs and roadways.
  - .5 All excavation and backfill for miscellaneous items such as bollards.

.2 The work of this Section comprises the furnishing of all labor, materials, and equipment necessary for the control of dust and other airborne pollutants or contaminants generated by the work of this project.

.3 It is the responsibility of the Contractor to perform the entire work of this project in a manner which will reduce airborne dust to an absolute minimum and prevent the blowing of dust beyond the limits of construction area. This will require the strict observance of all control measures specified in this Section and other restrictions as may be deemed necessary by the Contractor, Consultant or Owner's representative during the course of construction, including the requirement to cease operations.

.4 The requirements of the following Prince Edward Island, Department of Transportation & Infrastructure Specifications are to be followed for all work relating to the material specifications for fill materials.

1.2 RELATED REQUIREMENTS

.1 Section 02 41 16 - Structure Demolition.
.2 Section 31 22 19 - Finish Grading.
.3 Section 33 05 13 - Manholes and Structures.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

- .1 ASTM C117-03, Standard Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM C136-01, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D422-632002, Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft 3) (600 kN-m/m 3).
.5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft 3) (2,700 kN-m/m 3).
.6 ASTM D4318-00, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)
.1 CAN/CGSB-51.20-M87, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
.2 CAN/CGSB-51.34-M86, Vapor Barrier, Polyethylene Sheet for Use in Building Construction.

1.4 DEFINITIONS

.1 Dust as defined in this Section is any airborne particulate that may result from the work of this project, which includes, but is not limited to:
.1 Soil particles.
.2 Fertilizer.
.3 Limestone.
.4 Soil additives.
.5 Sand.

.2 Rock:
.1 Any solid material in excess of 1.00 m 3 and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m3 bucket. Frozen material not classified as rock.

.3 Common excavation:
.1 Excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.4 Topsoil:
.1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.

.5 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.6 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.7 Cohesionless soil: For compaction purposes, cohesionless soil is:
.1 Materials having less than 20% passing 75 micrometres sieve, regardless of plasticity of fines.

.8 Cohesive soil: For compaction purposes, cohesive soil is soil not having properties to be classified as cohesionless.

.9 Unsuitable materials:
.1 Weak, chemically unstable, and compressible materials.
.2 Frost susceptible materials:
.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422.
.2 Sieve sizes to CAN/CGSB-8.1.
.3 Table:

SIEVE DESIGNATION	**% PASSING**
2.00mm	100
0.10mm	45-100

SIEVE DESIGNATION	% PASSING
0.02mm	10-80
0.005mm	0-45

1.5 VEHICLE REQUIREMENTS

.1 All trucks bringing fill materials to site and removing surplus materials from site are to have a heavy-duty tarpaulin covering the truck box, properly tied down, to prevent the spillage of materials or blowing of dust during transportation.

.2 Vehicles not equipped with a tarpaulin will not be allowed on site.

1.6 WORK RESTRICTIONS

.1 Contractor will be required to stop work when wind speed, or unusually dry conditions are such, that in the Contractor's, Consultant's or Owner's representative's opinion, the control measures required under this Section are, or will be, unable to prevent the blowing of dust beyond the limits of the site.

1.7 AFTER WORKDAY REQUIREMENTS

.1 During unusually dry conditions and when predicted wind speed is of a velocity, that in the Contractor's, Consultant's or Owner representative's opinion will result in dust being blown beyond the limits of the site, the Contractor will continue the control measures specified in this Section throughout non-working hours, as required to prevent the blowing of dust.

1.8 PROTECTION OF EXISTING FEATURES

.1 Existing buried utilities and structures:

- .1 Size, depth and location of existing utilities and structures as indicated are for guidance only; completeness and accuracy are not guaranteed.
- .2 Prior to commencing any excavation work, notify applicable Utility or authorities, establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during work.
- .3 Confirm locations of buried utilities by careful test excavation.
- .4 Maintain and protect from damage, water, sewer, gas, electric or other utilities encountered.
- .5 Obtain direction of Consultant before moving or otherwise disturbing utilities or structures.
- .6 Where indicated, re-route existing lines in area of excavation.
- .7 Pay costs for such work.
- .8 Record in accordance with requirements of Section 01 78 00 - Closeout Submittals, locations of maintained, re-routed and abandoned underground services.
- .9 Make good and pay for damage to any lines resulting from work.

.2 Existing surface features:

- .1 Protect existing surface features, which may be affected by work from damage while work is in progress and repair damage resulting from work.
- .2 Where excavation necessitates root or branch cutting do so only under direct control of Consultant.
- .3 Provide protection around bench markers, layout markers, survey markers, geodetic monuments and signage.

1.9 SHORING BRACING AND UNDERPINNING

.1 Comply with Section 01 35 29 - Health, Safety, and Emergency Response Procedures and applicable local regulations and to protect existing features.

.2 Whenever shoring, sheeting, timbering and bracing of excavations or underpinning is required engage services of a Professional Engineer registered in Prince Edward Island, Canada, to design and assume responsibility for adequacy of shoring, bracing and underpinning.

.3 Design and supporting data submitted to bear the stamp and signature of qualified Professional Engineer registered in Canada.

1.10 COMPACTION DENSITIES

.1 Compaction densities indicated are Standard Proctor Maximum Dry Densities.

1.11 GENERAL REQUIREMENTS

.1 Following the removal of the 300mm of topsoil and rootmat under the work of Section 31 14 00 -Earth Stripping and Stockpiling, the Owner's Geotechnical Engineer will visually inspect the exposed underlying material and issue instructions with respect to the extent of the excavation, backfilling and compaction work required within the foundation walls.

.2 Do not proceed with any excavation work until instructions with respect to the extent of the work have been received from the Consultant. The cost of any geotechnical investigation work resultant from the Consultant's visual inspection will be borne by the Owner.

.3 For bidding purposes include for the removal of all existing in-situ material within the limits of the foundation walls down to the bottom of the new footings.

.4 For bidding purposes include for the supply, installation and compaction of Type 5 fill from the bottom of the new footings, up to the underside of the granular base for the floor slab.

.5 If, resultant from the Consultant's inspection, the underlying material is found to be acceptable, or acceptable in part, as a sub base for the structural fill and granular base for the floor slabs, the Contractor shall submit a credit quotation for the deletion or partial deletion of the excavation, backfilling and compaction work.

1.12 SUBMITTALS

.1 Samples:

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

.2 Inform Consultant at least 2 weeks prior to beginning Work, of proposed source of fill materials and provide analysis if requested.

1.13 DELIVERY, STORAGE AND HANDLING

.1 Storage and Protection:

.1 Protect existing features in accordance with Section 01 50 00 - Facilities and Controls and applicable local regulations.

1.14 WASTE MANAGEMENT AND DISPOSAL

.1 Collect and separate for disposal waste material in appropriate on-site bins in accordance with Waste Management Plan.

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

.3 Ensure emptied containers are sealed and stored safely.

.4 Divert excess aggregate materials from landfill for reuse.

2 Products

2.1 MATERIALS

.1 Type 1 Fill: Crushed rock composed of hard sound, durable uncoated, cubical fragments of consistent quality produced from non-sedimentary bedrock or non-sedimentary boulders, to comply with the P.E.I. Department of Transportation & Infrastructure Specification 401 - Aggregate, for Class 'A' material graded within the following limits:

ASTM SIEVE SIZE	PERCENT PASSING
31.55mm	100
25.0mm	95-100
12.5mm	50-83

ASTM SIEVE SIZE	PERCENT PASSING
4.75mm	30-60
1.18mm	15-40
600mm	10-32
300mm	5-22
75mm	3-9

.2 Type 2 Fill: Crushed rock composed of hard sound, durable uncoated, cubical fragments of consistent quality produced from non-sedimentary bedrock or non-sedimentary boulders, to comply with the P.E.I. Department of Transportation & Infrastructure Specification 401 - Aggregate, for Class 'B' material graded within the following limits:

ASTM SIEVE SIZE	PERCENT PASSING
31.55mm	100
25.0mm	95-100
12.5mm	50-83
4.75mm	30-60
1.18mm	15-40
600mm	10-32
300mm	5-22
75mm	3-9

.3 Type 3 Fill: imported, classified as Common Fill, or material from excavation or other sources, approved by Consultant for use intended, unfrozen, free from rocks larger than 75mm, cinders, ashes, sods, refuse or other deleterious materials.

.4 Type 4 Fill: natural sand or crushed rock screening, free from clay, shale or organic matter, to comply with P.E.I. Department of Transportation & Infrastructure Specification 402 - Bedding Sand, graded with the following limits:

ASTM SIEVE SIZE	PERCENT PASSING
9.5mm	100
4.75mm	87-98
2.36mm	55-95
1.18mm	30-90
600mm	10-70
300mm	0-35
150mm	0-15
75mm	0-8

.5 Type 5 Fill: to requirements of Prince Edward Island, Department of Transportation & Infrastructure 1998 Specification #206.02.02 - Select Borrow as follows:

.1 Borrow shall be non-plastic and composed of clean, uncoated particles free from lumps of clay or other deleterious material with a maximum particle size of 100mm, and a maximum of 30% of the material passing the 4.75 sieve shall pass the 0.075 mm sieve.

.6 Type 6 Fill: clean, washed coarse sand free from clay, shale and organic matter and graded within the following limits:

ASTM SIEVE SIZE	PERCENT PASSING
12.5mm	100
4.75mm	90-100
0.85mm	40-100
0.35mm	0-75

ASTM SIEVE SIZE	PERCENT PASSING
0.25mm	0-38
0.75mm	0-8

.7 Type 7 Fill: Crushed rock, composed of hard, sound, durable, uncoated, cubical fragments of consistent quality produced from non-sedimentary bedrock or non-sedimentary boulders, graded within the following limits, to comply with the P.E.I. Department of Transportation & Infrastructure Specification 401 - Aggregate for Class 'D' Material.

ASTM SIEVE SIZE	PERCENT PASSING
50.0mm	100
38.0mm	60-100
31.5mm	50-100
25.0mm	35-70
19.0mm	20-50
12.5mm	10-35
9.5mm	5-25
4.75mm	0-10

.8 Underslab Vapor Retarder: polyolefin film to meet ASTM E-1745 Class A, B and C.
- .1 Acceptable Material:
  - .1 Moistop Ultra 10 manufactured by Fortifiber Building Systems Group.
  - .2 Perminator, Sealtight distributed by W.R. Meadows.

.9 Insulation:Rigid insulation, Board insulation adhesive: Type A to CGSB 71-GP-24M, Type 2 (trowel applied), Class A.
- .1 Acceptable Material:
  - .1 Dow Styrofoam SM.10.
  - .2 Celfort Celfortec 300.
  - .3 Owens Corning Foamular C-300.

.10 Polyethylene film: 10 mil thickness.

2.2 EQUIPMENT

.1 For application of water use pressurized distributor equipped with a spray system that will ensure even distribution of controlled quantities of water with means of shut-off to avoid dumping of excess water.

.2 Following final grading and seeding use only a water distribution vehicle with tires of sufficient size that any impression left by the tires can, if necessary, be repaired by a light hand raking.

3 Execution

3.1 GENERAL

.1 Carry out work to prevent blowing dust and debris during construction.

3.2 APPLICATION

.1 Apply water over entire area of operation in sufficient quantities to prevent blowing of dust, but not to create excess moisture that will prevent segregation of materials, or interfere with proper placement of materials. Application of water is required at all stages of work, which includes, but is not limited to, the following.
- .1 Stripping of topsoil.
- .2 Excavation Work.
- .3 Grading operations.
- .4 Placement of fill materials.
- .5 Placement of topsoil.

.6 Removal of surplus materials.

3.3 PROTECTION OF STOCKPILES

.1 Apply water to materials during stockpiling operations and either cover stockpile at end of day or continue with application of water both during workday and after hours in to ensure acceptable dust control.

3.4 TRANSPORTATION OF MATERIALS

.1 Leave tarpaulins in place during dumping of fill materials being brought to the site.
.2 Water materials being loaded onto trucks for removal from site and secure tarpaulins before leaving loading area.

3.5 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly in accordance with Section 02 41 13 - Selective Site Demolition.

3.6 STRIPPING OF TOPSOIL

.1 Begin topsoil stripping of areas as indicated after area has been cleared of brush and removed from site.
.2 Strip topsoil to depths as indicated. Do not mix topsoil with subsoil.
.3 Stockpile in locations as indicated or directed by Consultant. Stockpile height not to exceed 2 m and should be protected from erosion.
.4 Dispose of unused topsoil to location as indicated.

3.7 STOCKPILING

.1 Stockpile fill materials in areas designated by Consultant. Stockpile granular materials in manner to prevent segregation.
.2 Protect fill materials from contamination.
.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.8 SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods.
.2 Obtain permit from authority having jurisdiction for temporary diversion of water course.
.3 Construct temporary Works to depths, heights and locations as indicated.
.4 Upon completion of substructure construction:
  .1 Remove shoring and bracing.
  .2 Remove excess materials from site.

3.9 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.
.2 Protect open excavations against flooding and damage due to surface run-off.
.3 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved collection and in manner not detrimental to public and private property, or portion of Work completed or under construction.
.4 Provide settling basins, or other facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.10 EXCAVATION

.1 Excavate to lines, grades, elevations and dimensions as indicated.
.2 Remove concrete and other obstructions encountered during excavation.

.3 Excavation must not interfere with normal 45° bearing splay of adjacent foundations.
.4 Following completion of excavation work and prior to placement of any structural fill material proof roll existing sub-grade exposed by excavation with a large vibratory roller (CAT CS-563E or equivalent). Remove 'soft' material and replace with new structural fill in accordance with requirements of this Section compacted to 100% density.
.5 Do not disturb soil within branch spread of trees or shrubs that are to remain.
.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
.6 For trench excavation, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 5m at end of day's operation.
.7 Keep excavated and stockpiled materials safe distance away from edge of trench.
.8 Restrict vehicle operations directly adjacent to open trenches.
.9 Dispose of surplus and unsuitable excavated material in approved location on site.
.10 Do not obstruct flow of surface drainage or natural watercourses.
.11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
.12 Notify Consultant when bottom of excavation appears unsuitable.
.13 Obtain Consultant's approval of completed excavation.
.14 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Consultant.
.15 Correct unauthorized over-excavation as follows:
.1 Fill under bearing surfaces and footings with Type 2 fill compacted to not less than 98% of corrected Standard Proctor maximum dry density.
.16 Hand trim, make firm and remove loose material and debris from excavations.
.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
.17 Rock excavation:
.1 For the purpose of bidding it is to be assumed that solid sandstone bedrock, as defined under Par. 1.4 above, will not be encountered during the work of this Section.

3.11 FILL TYPES AND COMPACTION

.1 Dimensions specified in following paragraphs are minimum dimensions of fill after compaction.
.2 Foundation walls:
.1 Backfill with Type 5 (structural) fill up to underside of granular base for floor slabs. Compact to 100% density, in lifts not exceeding 300mm.
.2 Excavated material may be used if uncontaminated and approved by testing laboratory.
.3 Install Type 1 fill (granular base) to thickness indicated, directly over structural fill, compacted to 100% density.
.4 Level granular base to accommodate full thickness of concrete floor slab.
.5 Install sheet vapour retarder in accordance with Par. 3.9 below.
.6 Where indicated, install rigid insulation boards.
.3 Exterior Concrete Structure:
.1 Backfill with Type 5 fill up to underside of granular base for concrete aprons at building exterior.
.2 Install Type 1 fill to thickness indicated, directly over structural fill, compacted to 100% density.
.3 Level granular base to accommodate full thickness of concrete aprons.
.4 Underground services:
.1 Use Type 4 Fill (bedding sand) to provide bedding and cover as indicated compacted full width of trench to minimum 95% density.
.2 Use excavated material to underside of granular base for floor slab at interior of addition, compacted to 100% density.

.3 Use Type 3 Fill to underside of topsoil at landscaped areas compacted to density at least equal to adjacent undisturbed soil or minimum 95%.

.5 Interior Concrete Slab on Grade (where applicable):

.1 Backfill with Type 5 Fill (select borrow) to a minimum thickness of 300 mm and to suit grade. Compact to 100% SPDD.

.2 Install Type 1 Fill minimum 300 mm compact to 100% SPDD, Class "A".

3.12 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.13 PERIMETER INSULATION

.1 Install horizontal perimeter board insulation to width and thickness indicated, directly under floor slabs, adjacent to exterior perimeter walls, as indicated.

.2 Install boards on walls using a Type A adhesive to temporarily support boards tight against face of wall until backfilling is complete.

.3 Install boards to tight fit against abutting boards.

3.14 BACKFILLING

.1 Do not proceed with backfilling operations until Consultant has inspected and approved installations.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Backfilling around perimeter foundation walls.

.1 Do NOT place fill material against perimeter foundation walls until:

.1 Concrete has cured for a minimum of 14 days.

.2 Floor structures are permanently in place, unless approved by Consultant. Provide bracing as directed by Consultant and leave in place until removal is approved by Consultant.

.3 Exercise care not to damage insulation at interior face of foundation walls and polyethylene slip sheet at exterior face of the foundation walls.

.5 Backfilling around site installations.

.1 Place bedding and surround material as specified and indicated in applicable Section for service or utility to be installed.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

.3 Place layers simultaneously on both sides of installed work to equalize loading.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 Permit concrete to cure for minimum of 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval has been obtained from Consultant or:

.2 If approved by Consultant erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Consultant.

.5 Place material by hand under, around and over installations until 600mm of cover is provided, except where specifically permitted otherwise. Dumping material directly on installations will not be permitted.

.6 Place backfill material in uniform layers not exceeding 150mm up to grades indicated. Compact each layer before placing succeeding layer. Use methods to prevent damage to installations.

3.15 SLIP SHEET/BOND BREAKER

.1 Polyethylene Slip Sheet/Bond Breaker

.1 Install 10mil polyethylene slip-sheet at exterior face of all foundation walls from top of footing to future finished grade. Provide temporary support until backfilling is completed.

.2 Use 10mil polyethylene sheet as bond breaker between foundation walls and slabs-on-grade and slabs on steel floor decking. Provide temporary support until slabs are placed. Trim flush with top of slab.

3.16 UNDERSLAB VAPOUR BARRIER

.1 Install underslab vapor barrier over entire area of granular base. Lap all joints minimum 300 mm and seal with water impermeable adhesive tape.

.1 Turn vapour barrier, minimum 100mm, up face of existing foundation walls, perimeter Insulation at exterior foundation walls and interior piers.

.2 Seal punctures in sheets before concrete is placed. Use patching material minimum 150 mm larger than puncture, and seal.

3.17 TESTING AND INSPECTION

.1 Testing of materials and inspection and testing of placement and compaction will be carried out by testing laboratory appointed and paid for in accordance with Section 01 29 83 - Payment Procedures for Testing Laboratory Services. Frequency of tests will be determined by the testing laboratory.

3.18 RESTORATION

.1 Upon completion of work, remove surplus materials and debris, trim slopes and correct defects noted by Consultant.

.2 Clean and reinstate areas affected by work to satisfaction of Consultant.

3.19 SURPLUS MATERIAL

.1 Coordinate with consultant to determine location on site where any surplus material is to be placed.

.2 Remove all soil contaminated with oil, gasoline, calcium chloride or other toxic or dangerous materials resulting from the work of this contract and dispose of in manner to minimize danger at site and in a manner and to a location off site approved by Provincial Authority governing such disposal.

END OF SECTION

1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 01 35 29 - Health, Safety and Emergency Response Procedures.

1.2 PROTECTION

.1 Protect in accordance with Section 01 35 43 - Environmental Procedures.
.2 Protect existing items designated to remain. In event of damage, immediately replace such items or make repairs to approval of Consultant and at no additional cost to Owner.
.3 Prevent movement, settlement or damage of existing bridge, adjacent utilities, paving, and adjacent grades. Provide bracing, shoring and underpinning required. Make good damage and be liable for injury caused by demolition.
.4 If safety of structure being repaired or utilities appear to be endangered, cease operations and notify Consultant. Take precautions to support structures. Do not resume operations until permission is granted by Consultant.

1.3 DESCRIPTION OF WORK

.1 Perform all demolition and removal as specified in this Section and indicated on the Drawings, which includes but is NOT limited to the items referenced under PART 3 - EXECUTION.

2 Products

2.1 NOT APPLICABLE

.1 Not applicable.

3 Execution

3.1 PREPARATION

.1 Inspect site and verify with Consultant items designated for removal and items to be salvaged and re-used.
.2 During demolition work provide protection to structure along adjacent properties.
.3 There are electrical wiring and water lines under the existing boardwalk. Locate and protect utility lines and services. Preserve in operating condition active utilities traversing site. Contractor is financially responsible for replacing damaged utilities.

3.2 DEMOLITION AND REMOVAL

.1 Remove items indicated for removal as indicated on drawings and as required to complete the work.
.2 Minimize dusting and keep dusty materials wetted.

3.3 PROTECTION

.1 Take all necessary precautions and provide all bracing, shoring, and underpinning to support structure, structures undergoing demolition, adjacent services, roads and walks, landscaping and grading.
.2 If during the demolition work a situation should develop or a condition be exposed which has the potential to endanger the safety of the workers, occupants or users of the structure in which demolition work is being carried out, or pedestrians and vehicles the Contractor will, cease operations, take whatever emergency action, in the Contractor's opinion, is required to ensure the immediate safety of the workers, users and notify the Consultant before continuing with the work

.3 Prevent debris from blocking surface drainage, or from damaging or otherwise interfering with mechanical and electrical systems, which must remain active, and/or in place.

3.4 DISPOSAL OF MATERIAL

.1 Dispose of all removed materials off site.
.2 Except where indicated to be re-used all removed materials become the property of the Contractor and are to be removed from the site and disposed of in a manner and in a location acceptable to Provincial Authority governing such disposal.
.3 Do not sell, burn or bury materials on site.
.4 Pay all fees that may be charged to dispose of materials at licensed disposal sites.

END OF SECTION

1 General

1.1 DESCRIPTION OF WORK

.1 This Section specifies the requirements for the materials, equipment and methods to be followed for production, placement and compaction of hot mix, hot laid asphalt concrete for pavement construction for the parking areas, including access driveways.

.2 The following Prince Edward Island Department of Transportation & Infrastructure Specifications will be followed for all work related to Hot Mix Asphalt Concrete Paving.

- .1 501 Asphalt Cement
- .2 502 Asphalt Prime
- .3 503 Asphalt Emulsions
- .4 601 Tack Coat Application
- .5 602 Prime Coat Application
- .6 603 Hot Mix Asphaltic Concrete
- .7 705 Cold Plane Construction Joint
- .8 907 Vehicle Configurations and Restrictions

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM D995-95b(2002), Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- .2 ASTM D1559-89, Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus, was withdrawn in 1998 with no replacement.

.2 Asphalt Institute (AI)

- .1 AI MS-2-1993, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes.
- .2 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse in accordance with Waste Management Plan.

.2 Divert unused asphalt materials from landfill.

.3 Divert unused aggregate materials from landfill for reuse as approved by Consultant.

.4 Unused protective coating material must be disposed of at an official hazardous material collections site as approved by Consultant.

.5 Unused protective coating material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

2 Products

2.1 MATERIALS

.1 Asphalt paving mixture: The current Prince Edward Island Department of Transportation & Infrastructure Specifications 603 and 501 for hot-mixed, hot-laid asphalt concrete shall govern the materials and composition of the asphalt concrete pavements.

- .1 Base: Mix designation 'A' - as per Specification 501
- .2 Seal: Mix designation 'C' - as per Specification 501

.2 Asphalt prime: In accordance with the PEI Department of Transportation & Infrastructure Specification 502.

.3 Asphalt emulsions: In accordance with the PEI Department of Transportation & Infrastructure Specification 503.

3 Execution

3.1 ASPHALT PRIME

.1 Apply asphalt prime over imported granular base in accordance with the requirements of PEI Department of Transportation & Infrastructure Specification 602, Paragraphs 602.01 to 602.04 inclusive.

3.2 ASPHALT CONCRETE PAVING

.1 Place and compact asphalt concrete base and seal courses in accordance with the requirements of PEI Department of Transportation & Infrastructure Specification 603 to thickness indicated on drawings.

3.3 ASPHALT TACK

.1 Apply asphalt tack between base and seal courses and elsewhere as applicable in accordance with the requirements of PEI Department of Transportation & Infrastructure Specification 601.

3.4 JOINTS

.1 Provide cold plane joint at intersection with existing roads and elsewhere as required in accordance with PEI Department of Transportation & Infrastructure Specification 705, Paragraphs 705.01 and 705.02.

3.5 VEHICLE REQUIREMENTS

.1 In accordance with PEI Department of Transportation & Infrastructure Specification 907.

3.6 TESTING AND INSPECTION

.1 Testing of asphalt materials and inspection and testing of placement and compaction to be carried out by testing laboratory engaged and paid by the Contractor, in accordance with Section 01 29 83 - Payment Procedures for Testing Laboratory Services. Frequency of tests to be determined by the testing laboratory.

3.7 SURPLUS MATERIALS

.1 Remove all surplus materials from site.
.2 Dispose off site at a location approved by Provincial Authority governing such disposal and pay all fees that may be charged to dispose of materials.

3.8 PROTECTION

.1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38 degrees C. Do not permit stationary loads on pavement until 24 hours after placement.
.2 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 03 20 00 - Concrete Reinforcing.
.2 Section 03 30 00 - Cast-in-Place Concrete.
.3 Section 31 23 00 - Excavation and Fill.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM International)
  .1 ASTM C139-17, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
  .2 ASTM C478M-19, Specification for Precast Reinforced Concrete Manhole Sections Metric.
.2 Canadian Standards Association (CSA International)
  .1 CAN/CSA-A3000-13, Cementitious Materials Compendium. Includes:
    .1 CAN/CSA-A5-98, Portland Cement.
    .2 CAN/CSA-A8-98, Masonry Cement.
    .3 CAN/CSA-A23.5-98, Supplementary Cementing Materials.
  .2 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
  .3 CAN/CSA-G30.18-09(R2014), Billet Steel Bars for Concrete Reinforcement.
  .4 CAN/CSA-G164-2018, Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit manufacturer's drawings, information and shop drawings.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Collect and separate for disposal waste material and place in appropriate on-site bins in accordance with Waste Management Plan.
.2 Divert unused concrete materials from landfill.
.3 Divert unused aggregate materials from landfill.

2 Products

2.1 MATERIALS

.1 Materials
  .1 Precast sanitary and storm manhole sections: to ASTM C478M, circular or oval. Top sections eccentric cone with opening offset for vertical ladder installation. Units to have integral precast base section with benching at sanitary manholes and performed gasketed openings for pipes.
  .2 Provide openings in walls of manholes as required to suit size and inverts of lines. Confirm size and invert before fabrication.
  .3 Acceptable Material:
    .1 Campbells' Concrete Ltd.
    .2 L.E. Shaw Limited.
  .4 Frames, gratings, covers to plan dimensions and following requirements:
    .1 Manhole frames and cover: heavy duty municipal type for road service. Cover cast without perforations and complete with two - 1 inch square lifting holes.
    .2 Acceptable Material:
      .1 Hall and Stavert No. 26 or equal.

.5 Cast-in-place base slab: use permitted only where use of integral base in not practical and when approved by Consultant.
.6 Concrete Grout:
.1 Non shrink, non metallic, grout capable of developing compression strength of 50mPa at 28 days.
.2 Acceptable Material: Meadows "Sealtight CG-86"

.2 Precast catch basin sections: to ASTM C139, ASTM C478M.
.1 Acceptable material:
.1 Campbells' Concrete Ltd.
.2 L.E. Shaw Limited.

.3 Joints: to be made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.
.4 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164. Rungs to be safety pattern (drop step type).
.5 Adjusting rings: to ASTM C478M.
.6 Drop manhole pipe: to be same as sewer pipe.

3 Execution

3.1 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 31 23 00 - Excavation and Fill and as indicated.
.2 Obtain approval of Consultant before installing outfall structures, manholes or catch basins.

3.2 CONCRETE WORK

.1 If required, do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
.2 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.
.3 Position metal inserts in accordance with dimensions and details as indicated.

3.3 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
.2 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
.3 Dewater excavation to approval of Consultant and remove soft and foreign material before placing concrete base.
.4 Installation of units:
.1 Set precast concrete base section to ensure proper alignment and invert elevations, on minimum 150mm of imported granular material compacted to 100% corrected maximum dry density. When use of cast-in-place base slab approved set bottom section of manhole in bed of cement mortar and bond to concrete slab.
.2 When cast-in-place slab approved set bottom section of manhole in bed of cement mortar and bond to concrete slab.
.3 Make each successive joint watertight with approved rubber ring gaskets or bituminous compound. If bituminous compound used, apply to CGSB 56-GP-9A.
.4 Clean surplus grout and joint compounds from interior surface of unit as work progresses.
.5 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.5 For sanitary sewers:
.1 When use of cast-in-place base slab approved by Consultant bench to provide a smooth U-shaped channel. Side height of channel to be full diameter of sewer. Slope adjacent floor at 1 in 10 toward channel. Curve channels smoothly. Slope invert to establish sewer grade.
.6 Compact granular backfill to 95% corrected maximum dry density.

.7 Place frame and cover on top section to elevation as indicated. If adjustments required use concrete rings to suit finished grade elevations.
.8 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
.9 Install safety platforms in manholes having depth of 5 m or greater, as indicated.

3.4 NEW CONNECTION AT EXISTING STORM/SANITARY MANHOLE

.1 Core drill opening in wall of existing manhole to suit diameter and invert of new storm/sanitary line connection, complete with rubber ring.
.2 Fit rubber ring on pipe to place it at the center of the wall of the manhole. Grout line in place from both sides and make watertight.
.3 Provide cast-in-place concrete saddle to support existing piping where new pipe crosses an existing pipe and where the distance is less than 300mm.

3.5 LEAKAGE TEST

.1 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer manhole and fill manhole with water. Leakage not to exceed 0.3% per hour of volume of manhole.
.2 If permissible leakage is exceeded, correct defects. Repeat until approved by Consultant.

END OF SECTION

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