
1 SUMMARY OF WORK

- .1 Work covered by Contract Documents:
 - .1 Work under this Contract comprises construction of a health care building expansion and renovation work as indicated, located at Mission Minimum Institution, Mission, B.C.
- .2 Contractor's Use of Premises:
 - .1 Contractor has controlled use of site within the construction area for Work, storage, and access as directed by the Departmental Representative.
 - .2 Use of areas inside Mission Institution, for access to the construction site is controlled, by the Departmental Representative.
 - .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
 - .4 The new building will be constructed inside the security fence. The institution will be fully operational during work of this Contract. Provide temporary construction fence around site until new security fencing is installed.
- .3 Conform to National Building Code 2015 or British Columbia Building Code 2012 as applicable.
- .4 Contractor to apply for Building Permit before construction and Occupancy Permit upon Substantial completion.
 - .1 Departmental Representative will supply the required drawings and Letters of Assurance for such applications.
 - .2 Contractor to pay for all required fees for Building Permit and Occupancy Permit.
 - .3 Before issuing the Substantial Completion certificate, Contractor must provide fire alarm verification report and Occupancy Permit from local authority having jurisdiction.

2 WORK RESTRICTIONS

- .1 Notify, Departmental Representative of intended interruption of disconnected services and provide schedule for review. Schedule major disruption of services in existing during approved times.
- .2 Where Work involves breaking into or connecting to existing service lines, give departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions to a minimum. Coordinate interruptions affecting existing building if affected by the disruption.
- .3 Construct barriers in accordance with Temporary Barriers and Enclosures clause.
- .4 Security Requirements: refer to Section 01 14 10 - Security requirements.
- .5 Hours of work:
 - .1 Perform work during normal working hours of the Institution (0730 to 1600), Monday through Friday except holidays. Work may be performed after normal working hours of the Institution, Monday through Friday, on weekends and holidays, with a minimum forty-eight (48) hours advance notice and approval of the Departmental Representative. Provide schedule for prior approval of Departmental

- Representative.
- .2 Allow for delays due to security protocol when work interferes with Institution security operations.
- .6 Access into Institution is required:
 - .1 Vehicular access through the Principal Entrance sally port will be restricted during the inmate "count" at breakfast, lunch and dinner hours. Confirm "count" times with Departmental Representative. Delays may occur when entering and exiting the Institution with vehicles during "count" times and due to security situations and heavy traffic.
 - .2 A construction escort will be provided by the Departmental Representative, at no cost to the Contract when access is required inside institution. Notify Departmental Representative minimum 24 hours in advance of when Construction Escort is required.

3 CONSTRUCTION MEETINGS

- .1 During Construction, Consultant will record project meetings,
- .2 Contractor shall update construction work schedule, contemplated change notices and change order check lists for each project meeting.

4 CONSTRUCTION WORK SCHEDULE

- .1 Commence work immediately upon official notification of acceptance of offer and complete the work within thirty (30) weeks from the date of such notification.
- .2 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Certificate and Final Certificate as defined times of completion are of essence of this contract.
- .3 Submittals:
 - .1 Submit to Departmental Representative within ten (10) working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of construction progress.
 - .2 Identify each trade or operation for each phase of the work.
 - .3 Show dates for delivery of items requiring long lead time.
 - .4 Departmental Representative will review schedule and return one copy.
 - .5 Re-submit two (2) copies of finalized schedule to Departmental Representative within five (5) working days after return of reviewed preliminary copy.
- .4 Project Scheduling Reporting:
 - .1 Update Project Schedule on monthly basis reflecting activity changes and completions, as well as activities in progress.
 - .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
- .5 Project Meetings:
 - .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind

schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

- .2 Weather related delays with their remedial measures will be discussed and negotiated.
- .3 Before submitting first progress claim submit breakdown of Contract price in detail as directed by Departmental Representative and aggregating contract price. After approval by Departmental Representative cost breakdown will be used as basis for progress payments.

5 SUBMITTAL PROCEDURES

- .1 Administrative:
 - .1 Submit to Departmental Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work.
 - .2 Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .3 Do not proceed with work affected by submittal, until review is complete.
 - .4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
 - .5 Where items or information is not produced in SI Metric units converted values are acceptable.
 - .6 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
 - .7 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
 - .8 Verify field measurements and affected adjacent Work are coordinated.
 - .9 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittals.
 - .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
 - .11 Keep one reviewed copy of each submission on site.
- .2 Shop Drawings:
 - .1 Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.
- .3 Product Data:
 - .1 Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that the product concerned is clearly identified. Submit in sets, not as individual submissions.
- .4 Samples:
 - .1 Submit samples in sizes and quantities specified.
 - .2 Where colour is criterion, submit full range of colours.
 - .3 Submit all samples as soon as possible after the contract is awarded, to facilitate

production of complete colour scheme by the Departmental Representative.

- .5 Mock-ups:
 - .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
 - .2 Construct in location as specified in specific Section.
 - .3 Prepare mock-ups for Departmental Representative' review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
 - .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .5 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

- .6 Submission Requirements:
 - .1 Schedule submissions at least ten days before dates reviewed submissions will be needed.
 - .2 Submit number of copies of product data, shop drawings which Contractor requires for distribution plus four (4) copies which will be retained by Departmental Representative.
 - .3 Accompany submissions with transmittal letter in duplicate.
 - .4 Submit either bond copies or one (1) electronic pdf file of each shop drawing and product data as directed by Departmental Representative.

- .7 Coordination of Submissions:
 - .1 Review shop drawings, product data and samples prior to submission.
 - .2 Coordinate with field construction criteria.
 - .3 Verify catalogue numbers and similar data.
 - .4 Coordinate each submittal with requirements of the work of all trades and contract documents.
 - .5 Responsibility for errors and omissions in submittals is not relieved by Departmental Representative's review of submittals.
 - .6 Responsibility for deviations in submittals from requirements of Contract documents is not relieved by Departmental Representative's review of submittals, unless Departmental Representative gives written acceptance of specified deviations.
 - .7 Notify Departmental Representative, in writing at time of submission, of deviations in submittals from requirements of Contract documents.
 - .8 Make any changes in submissions which Departmental Representative may require consistent with Contract Documents and re-submit as directed by Departmental Representative.
 - .9 After Departmental Representative's review, distribute copies.
 - .10 Shop Drawings Review:
 - .1 Review of shop drawings by Public Works and Government Services Canada (PWGSC) is for the sole purpose of ascertaining conformance with the general concept.
 - .2 The Departmental Representative's review does not mean that PWGSC approves the detail design inherent in the shop drawings, responsibility remains with the contractor submitting same, and such review will not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the

construction and contract documents.

- .3 Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work of all sub trades.

6 HEALTH AND SAFETY

- .1 Specified in Section 01 35 33 - Health and Safety Requirements.

7 ENVIRONMENTAL PROCEDURES

- .1 Fires and burning of rubbish on site not permitted.
- .2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.
- .3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.
- .4 Provide temporary drainage and pumping as necessary to keep excavations and site free from water during excavation and grading activities.
- .5 Control disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements. Construct settlement ponds and silt fences as required by the Provincial Environmental authority.
- .6 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .7 Under no circumstances dispose of rubbish or waste materials on property or CSC waste bins.

8 REGULATORY REQUIREMENTS

- .1 References and Codes:
 - .1 Perform Work in accordance with National Building Code of Canada (NBCC 2015) or British Columbia Building Code 2012, including all amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
 - .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

9 QUALITY CONTROL

- .1 Inspection:
 - .1 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
 - .2 If Contractor covers or permits to be covered Work that has been designated for

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- special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .3 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.
- .2 Independent Inspection Agencies:
 - .1 Provide independent Inspection/Testing Agencies for purpose of inspecting and/or testing portions of Work as specified in relevant sections. Cost of such services will be borne by the Contractor.
 - .2 Provide equipment required for executing inspection and testing by appointed agencies.
 - .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
 - .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no extra cost to Contract. Pay costs for retesting and re-inspection.
 - .3 Procedures:
 - .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
 - .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
 - .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.
 - .4 Rejected Work:
 - .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
 - .2 Make good other Contractor's work damaged by such removals or replacements promptly.
 - .5 Reports:
 - .1 Submit (4) four copies or one scanned pdf copy of inspection and test reports to Departmental Representative.
 - .6 Tests and Mix Designs:
 - .1 Furnish test results and mix designs as may be requested.
 - .7 Mock-ups;
 - .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
 - .2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.

- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
 - .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .5 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.
 - .6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- .8 Mill Tests:
- .1 Submit mill test certificates as requested and as required of specification Sections.
- .9 Equipment and Systems:
- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
 - .2 Refer to specific Section for definitive requirements.

10 TEMPORARY UTILITIES

- .1 Electrical power and lighting ,may be used for construction purposes at no extra cost, provided that guarantees are not affected thereby and electrical components used for temporary power are replaced when damaged.
- .2 Installation and Removal:
- .1 Provide temporary utilities controls in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .3 Dewatering:
- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.
- .4 Water Supply:
- .1 Existing water supply system may be used for construction purposes provided that damaged components are replaced when damaged. Provide own hoses from source.
- .5 Temporary Heating and Ventilation:
- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
 - .2 Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted.
 - .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in

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- progress.
- .6 The air system will be in use during work of this contract inside existing building. Protect ducting system by filters inspected daily and replaced as necessary. During dust generating construction work block off all outlets and seal air tight.
 - .1 Before Substantial Completion comply with the following conditions:
 - .1 Remove all temporary duct covers.
 - .2 Replace used air filters with new filters.
 - .7 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
 - .8 Activate air system under direction of Departmental Representative to provide temporary heat. Protect ducting system by filters inspected daily and replaced as necessary.
 - .1 Before Substantial Completion comply with the following conditions:
 - .1 Bring plant and systems to as new conditions. (Vacuum clean duct system.)
 - .2 Replace used air filters with new filters.
 - .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
 - .10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.
- .2 Temporary Power and Light:
 - .1 Arrange, and maintain temporary electric power supply in accordance with local power authority governing regulations and ordinances.
 - .2 Electrical power and lighting installed under this contract may be used for construction purposes at no extra cost, provided that guarantees are not affected thereby and electrical components used for temporary power are replaced when damaged.
 - .3 Replace lighting bulbs/tubes used for more than three months or provide replacement bulbs/tubes and hand over to Departmental Representative.
 - .3 Temporary Communication Facilities:
 - .1 Provide and pay for temporary telephone and fax hook up, line(s) necessary for own use. Conform to Section 01 14 10 Security Requirements.
 - .4 Fire Protection:
 - .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

11 CONSTRUCTION FACILITIES

- .1 Installation and Removal:
 - .1 Provide construction facilities in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .2 Scaffolding:
 - .1 Design, construct and maintain scaffolding in rigid, secure and safe manner, in accordance with WCBBC regulations and Section 01 35 33.
 - .2 Erect scaffolding independent of walls. Remove promptly when no longer required.
- .3 Hoisting/lifts:
 - .1 Provide, operate and maintain hoists/lifts required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
 - .2 Hoists/lifts: operated by qualified operator.
- .4 Site Storage/Loading:
 - .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
 - .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.
- .5 Construction Parking:
 - .1 Make good damage to local roads used for access to project site.
 - .2 Parking space is available outside double fence and temporary parking of delivery vehicles within construction site as directed by the Departmental Representative.
- .6 Contractor's Site Office:
 - .1 Provide office as required to accommodate Contractor's operations.
 - .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
- .7 Equipment, Tools and Material Storage:
 - .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
 - .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.
- .8 Sanitary Facilities:
 - .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .9 Construction Signs:
 - .1 Format, location and quantity of site signs and notices to be approved by Departmental Representative.
 - .2 Signs and notices for safety or instruction to be in English language, or commonly understood graphic symbols.
 - .3 Maintain signboards, signs and notices for duration of project. Remove and dispose of signs off site when directed by Departmental Representative.
 - .4 Remove signs from site at completion of project or as directed by Departmental Representative.

12 TEMPORARY BARRIERS AND ENCLOSURES

- .1 Enclosure of Structure:
 - .1 Provide temporary weather tight secure protection for exterior openings until permanently enclosed. Design enclosures to withstand wind pressure. Secure construction areas inside institution with fenced area to secure materials and temporary buildings.
 - .2 Provide temporary dust screens in existing building where dust generating work occurs.
- .2 Guardrails and Excavations:
 - .1 Provide secure, rigid guard rails and barricades around deep excavations, open edges of floors and roofs in accordance with WCB requirements.
- .3 Access to Site:
 - .1 Maintain existing access roads and designated parking area in broom clean condition.
- .4 Protection of Building Finishes:
 - .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
 - .2 Provide necessary screens, covers, and hoardings.
 - .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
 - .4 Be responsible for damage incurred due to lack of or improper protection.

13 COMMON PRODUCT REQUIREMENTS

- .1 Reference Standards:
 - .1 If there is a question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
 - .2 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
 - .3 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.
- .2 Quality:
 - .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
 - .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
 - .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
 - .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
 - .5 Permanent labels, trademarks and nameplates on products are not acceptable in

prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms

- .3 Storage, Handling and Protection:
 - .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
 - .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
 - .3 Store products subject to damage from weather in weatherproof enclosures.
 - .4 Store cementitious products clear of earth or concrete floors, and away from walls.
 - .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
 - .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
 - .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
 - .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
 - .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

- .4 Transportation:
 - .1 Pay costs of transportation of products required in performance of Work.
 - .2 Transportation cost of products supplied by Departmental Representative will be paid for by Departmental Representative. Unload, handle and store such products.

- .5 Manufacturer's Instructions:
 - .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
 - .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.
 - .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

- .6 Quality of Work:
 - .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
 - .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
 - .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

- .7 Co-ordination:

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- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
 - .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- .8 Concealment:
- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
 - .2 Before installation, inform Departmental Representative if there is interference. Install as directed by Departmental Representative.
- .9 Remedial Work:
- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
 - .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.
- .10 Location of Fixtures:
- .1 Inform Departmental Representative of conflicting installation. Install as directed.
 - .2 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.
- .11 Fastenings:
- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
 - .2 Prevent electrolytic action between dissimilar metals and materials.
 - .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
 - .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
 - .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
 - .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- .12 Fastenings - Equipment:
- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
 - .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
 - .3 Bolts may not project more than one diameter beyond nuts.
 - .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.
- .13 Protection of Work in Progress:
- .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Departmental Representative.
- .14 Existing Utilities:

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by Departmental Representative and governing authorities, with minimum of disturbance to pedestrian and vehicular traffic. Maintain vehicular access on roadways at all times.
- .2 Before commencing work, establish location and extent of service lines in areas of work and notify Departmental Representative of findings.
- .3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
- .4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .5 Record locations of maintained and re-routed services lines.

14 EXAMINATION AND PREPARATION

- .1 Existing Services:
 - .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
 - .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.
- .2 Location of Equipment and Fixtures:
 - .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
 - .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
 - .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
 - .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

15 EXECUTION REQUIREMENTS

- .1 Preparation:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .2 After uncovering, inspect conditions affecting performance of Work.
 - .3 Beginning of cutting or patching means acceptance of existing conditions.
 - .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
 - .5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.
- .2 Execution:
 - .1 Execute cutting, fitting, and patching, including excavation and fill, to complete Work.
 - .2 Fit several parts together, to integrate with other Work.
 - .3 Uncover Work to install ill-timed Work.
 - .4 Remove and replace defective and non-conforming Work.
 - .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire stopping material, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

16 CLEANING

- .1 Project Cleanliness:
 - .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
 - .2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
 - .3 Provide on-site containers for collection of waste materials and debris.
 - .4 Provide and use clearly marked separate bins for recycling. Refer to- Construction/Demolition Waste Management and Disposal.
 - .5 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
 - .6 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
 - .7 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
 - .8 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
 - .9 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .2 Final Cleaning:
 - .1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
 - .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
 - .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
 - .4 Remove waste products from site.
 - .5 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
 - .6 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical

- fixtures, furniture fitments, walls, and floors.
- .7 Clean lighting reflectors, lenses, and other lighting surfaces.
- .8 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .9 Wax, seal, vacuum clean, shampoo or prepare floor finishes, as recommended by manufacturer.
- .10 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .11 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .12 Remove dirt and other disfiguration from exterior surfaces.
- .13 Sweep and wash clean paved areas used during work of this contract.
- .14 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .15 Clean roofs, downspouts, and drainage systems.
- .16 Remove snow and ice from access to building.

17 CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL

- .1 Prior to beginning of Work on site submit a detailed Waste Reduction Workplan in Accordance with Section 01 01 50- General Instructions and indicate:
 - .1 Descriptions of and anticipated quantities in percentages of materials to be salvaged, reused, recycled and landfilled.
 - .2 Schedule of selective demolition.
 - .3 Number and location of dumpsters.
 - .4 Anticipated frequency of tippage.
 - .4 Name and address of haulers and waste receiving organizations.
- .2 Government mandate is to reduce the environmental impact of waste by diverting at least 90% by weight of all construction and demolition waste. Indicate compliance with this mandate.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials and waste. Separate non-salvageable materials from salvaged items. Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Provide containers to deposit reusable and/or recyclable materials. Locate containers in locations, to facilitate deposit of materials without hindering daily operations. Provide containers to deposit reusable and/or recyclable materials.
- .5 Collect, handle, store on-site and transport off-site, salvaged materials in separate condition. Transport to approved and authorized recycling facility and/or users of material for recycling.
- .6 Locate waste and salvage bins on site as directed by Departmental Representative.

18 CLOSEOUT PROCEDURES

- .1 Inspection and Declaration:
 - .1 Contractor's Inspection: Conduct an inspection of Work with all subcontractors, identify deficiencies and defects, and repair as required to conform to Contract

- Documents.
- .2 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
- .3 Request Departmental Representative's Inspection.
- .2 Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by HRSDC Fire Protection Engineering, Utility companies have been submitted.
 - .5 Operation of systems have been demonstrated to Department's personnel.
 - .6 Work is complete and ready for Final Inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

19 CLOSEOUT SUBMITTALS

- .1 Record Drawings:
 - .1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on as-built drawings as changes occur. At completion supply:
 - .1 Four (4) set of CD's in AutoCad file format (version: 2007) with all as-built information on the diskettes.
 - .2 Four (4) sets of printed as-built drawings.
 - .3 Submit one copy of check plots to Departmental Representative prior to final printing of as-built drawings.
 - .4 Departmental Representative will supply copies of the original AutoCad files.
 - .5 Retain original logo and title block on the as-built drawings. Contractor may place on the upper right-hand title block area a small company logo, the text "AS-BUILT" and the date.
 - .2 Costs for transferring as-built information from marked up working set of drawings to electronic format using ACAD and plotting service is included in the Contract.
- .2 Maintenance manual:
 - .1 On completion of project submit to Departmental Representative four (4) CD R/ disk copies and four paper (in loose leaf type binder) of Operations and Maintenance Manual, made up as follows:
 - .1 Provide maintenance manual on CDs using pdf, or other approved format for descriptive writing, page size images and page size drawings. Organize manuals into industry standard maintenance manual tabs with links in index to each descriptive section describing the component or maintenance procedure etc.
 - .2 Organize files into CSI Masterformat numbering system or other approved descriptive titles.

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- .3 Label disk "Operation and Maintenance Data", project name, date, names of Contractor, subcontractors, consultants and sub consultants.
 - .4 Include scanned guarantees, diagrams and drawings.
 - .5 Organize contents into applicable sections of work to parallel project specification break-down. Mark each section by labeled tabs (navigational buttons).
 - .6 Drawings, diagrams and manufacturer's literature must be legible.
 - .7 Refer to Mechanical and Electrical Divisions for specific details for Mechanical and Electrical data.
- .3 Maintenance Materials, Special Tools and Spare Parts:
- .1 Specific requirements for maintenance materials, tools and spare parts are specified in individual sections.
 - .2 Deliver maintenance materials, special tools and spare parts to Departmental Representative and store in designated area as directed by Departmental Representative.
 - .3 Prepare lists of maintenance materials, special tools and spare parts for inclusion in Manual specified in Clause 18.2.
 - .4 Maintenance materials:
 - .1 Deliver wrapped, identify on carton or package, colour, room number, system or area as applicable where item is used.
 - .5 Special tools:
 - .1 Assemble as specified;
 - .2 Include identifications and instructions on intended use of tools.
 - .6 Spare parts:
 - .1 Assemble parts as specified;
 - .2 Include part number, identification of equipment or system for which parts are applicable;
 - .3 Installation instructions;
 - .4 Name and address of nearest supplier.
- .4 Warranties and Bonds:
- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing in maintenance manual.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
 - .4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Interim Completion is determined.
 - .5 Verify that documents are in proper form, contain full information, and are notarized.
 - .6 Retain warranties and bonds until time specified for submittal.

20 DEMONSTRATION AND TRAINING

- .1 Demonstration and Training:
 - .1 Demonstrate operation and maintenance of equipment and systems to maintenance personnel following interim Completion and prior to date of final certificate of completion
 - .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

END OF SECTION

1 PURPOSE

- .1 To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.

2 DEFINITIONS

- .1 "Contraband" means:
 - .1 an intoxicant, including alcoholic beverages, drugs and narcotics
 - .2 a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization,
 - .3 an explosive or a bomb or a component thereof,
 - .4 currency over any applicable prescribed limit, \$25.00, and
 - .5 any item not described in paragraphs (a) to (d) that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2 "Unauthorized smoking and related Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, matches and lighters.
- .3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4 "CSC" means Correctional Service Canada.
- .5 "Director" means Director, Warden or Superintendent of the Institution as applicable.
- .6 "Construction employees" means persons working for the general contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .7 "Departmental Representative" means the Public Works and Government Services Canada representative defined in General Conditions.
- .8 "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.
- .9 "Construction limits" means the area, as indicated in the contract documents, that the contractor will be allowed to work". This area may or may not be isolated from the security area of the institution. Limits to be confirmed at construction start-up meeting.

3 PRELIMINARY PROCEEDINGS

- .1 At construction start-up meeting:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 The Contractors's responsibilities:
 - .1 Ensure that all construction employees are aware of the security requirements.
 - .2 Ensure that a copy of the security requirements is always prominently on display at the job site.
 - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all construction employees.

4 CONSTRUCTION EMPLOYEES

- .1 Submit to the Departmental Representative a list of the names with date of birth of all construction employees to be employed on the construction site and a security clearance form for each employee.

- .2 Allow 10 working days for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at this institution except as approved otherwise.
- .3 The Director may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Director may require that these Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked up upon arrival at the Institution and be displayed prominently on the construction employees clothing at all times while employees are in the institution.
- .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
 - .1 appear to be under the influence of alcohol, drugs or narcotics.
 - .2 behave in an unusual or disorderly manner.
 - .3 are in possession of contraband.

5 VEHICLES

- .1 All unattended vehicles on CSC property must have windows closed; fuel caps locked, doors and trunks locked and keys removed. The keys must be securely in the possession of the owner or an employee of the company that owns the vehicle.
- .2 The director may limit at any time the number and type of vehicles allowed within the Institution.
- .3 Drivers of delivery vehicles for material required by the project will require security clearances and must remain with their vehicle the entire time that the vehicle is in the Institution. The director may require that these vehicles be escorted by Institutional staff or PWGSC Construction Escorts while in the Institution.
- .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, the trailer doors must be locked at all times. All windows must be securely locked bars when left unoccupied. Cover all windows with expanded metal mesh. When not in use lock all storage trailers located inside and outside the perimeter.

6 PARKING

- .1 The parking area(s) to be used by construction employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.

7 SHIPMENTS

- .1 To avoid confusion with the institution's own shipments, address all shipments of project material, equipment and tools in the Contractor's name and have a representative on site to receive any deliveries or shipments. CSC or PWGSC staff will **NOT** accept receipt of deliveries or shipments of any material equipment or tools.

8 TELEPHONES

- .1 The installation of telephones, facsimile machines and computers with Internet connections is not permitted within the Institution perimeter unless prior approved by the Director.
- .2 The Director will ensure that approved telephones, facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved

password protection that will stop an Internet connection to unauthorized personnel.

- .3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, Blackberries, telephone used as 2-way radios are not permitted within the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.
- .4 The Director may approve but limit the use of 2-way radios.

9 WORK HOURS

- .1 Conform to Division 1.
- .2 Work is not permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waived by the Director.

10 OVERTIME WORK

- .1 Conform to Division 1.
- .2 Provide 48 hours advance notice to Director for all work to be performed after normal working hours of the Institution. Notify Director immediately if emergency work is required, such as to complete a concrete pour or make the construction site safe and secure.

11 TOOLS AND EQUIPMENT

- .1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required by the Institution.
- .2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
- .3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
- .4 Store all tools and equipment in approved secure locations.
- .5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor. Secure and lock scaffolding when not erected and when erected Secure in a manner agreed upon with the Institution designate.
- .6 Report all missing or lost tools or equipment immediately to the Departmental Representative/Director.
- .7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
 - .1 At the beginning and conclusion of every work day or shift upon entering and exiting the Institution.
 - .2 At any time when contractor is on Institution property.
- .8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day. Maintain

up to date inventory of all used blades/cartridges.

- .9 If propane or natural gas is used for heating the construction, the institution will require that the contractor supervise the construction site during non-working hours.

12 KEYS

- .1 Security Hardware Keys.
 - .1 Arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO).
 - .2 The SMO will provide a receipt to the Contractor for security hardware keys.
 - .3 Provide a copy of the receipt to the Departmental Representative.
- .2 Other Keys
 - .1 Use standard construction cylinders for locks for his use during the construction period.
 - .2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.
 - .3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:
 - .1 Prepare an operational keying schedule
 - .2 Accept the operational keys and cylinders directly from the lock manufacturer.
 - .3 Arrange for removal and return of the construction cores and install the operational core in all locks.
 - .4 Upon putting operational security keys into use, the PWGSC construction escort shall obtain these keys as they are required from the SMO and open doors as required by the Contractor. The Contractor shall issue instructions to his employees advising them that all security keys shall always remain with the PWGSC construction escort.

13 SECURITY HARDWARE

- .1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.

14 PRESCRIPTION DRUGS

- .1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.

15 SMOKING RESTRICTIONS

- .1 Smoking is not permitted inside correctional facilities or outdoors within the perimeter of a correctional facility and persons must not possess unauthorized smoking items within the perimeter of a correctional facility.
- .2 Persons in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist will be directed to leave the Institution.
- .3 Smoking is permitted outside the perimeter of a correctional facility in an area designated by the Director.

16 CONTRABAND

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.
- .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.

- .3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.
- .4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

17 SEARCHES

- .1 All vehicles and persons entering institutional property may be subject to search.
- .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband, he may order that person to be searched.
- .3 All employees entering the Institution may be subject to screening of personal effects for traces of contraband drug residue.

18 ACCESS TO AND REMOVAL FROM INSTITUTIONAL PROPERTY

- .1 Construction personnel and commercial vehicles will not be admitted to the institution after normal working hours, unless approved by the Director.

19 MOVEMENT OF VEHICLES

- .1 Escorted commercial vehicles may not be allowed to enter or leave the institution through the vehicle access gate during the regular "inmate count" occurring at breakfast, lunch and dinner hour as established by the Institution. Confirm "count" times with Director or Departmental Representative to reduce down times for deliveries to Institution and movement of contractors vehicles through Institution vehicle access gate.
- .2 Construction vehicles will not be allowed to leave the Institution until an inmate count is completed.
- .3 The contractor shall advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .4 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or PWGSC construction escorts working under the authority of the Director.
- .5 Commercial vehicles will only be allowed access to institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.
- .6 Vehicles shall be refused access to institutional property if, in the opinion of the Director, they contain any article which may jeopardize the security of the institution. Arrange with Director for parking of contractor's vehicles at minimum security Institutions.
- .7 Private vehicles of construction employees will not be allowed within the security wall or fence of medium or maximum security institutions without the permission of the Director.
- .8 With prior approval of the Director, a vehicle may be used in the morning and evening to transport a group of employees to the work site. This vehicle will not remain within the Institution the remainder of the day.
- .9 With the approval of the Director, certain equipment may be permitted to remain on the construction

site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.

20 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY

- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Director may:
 - .1 Prohibit or restrict access to any part of the institution.
 - .2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when accompanied by a member of the CSC security staff.
- .3 During the lunch and coffee/health breaks, all employees will remain within the construction site. Employees are not permitted to eat in the officer's lounge and dining room.

21 SURVEILLANCE AND INSPECTION

- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

22 STOPPAGE OF WORK

- .1 The director may request at any time that the contractor, his employees, sub-contractors and their employees not enter or leave the work site immediately due to a security situation occurring within the Institution. The contractor's site supervisor shall note the name of the staff member making the request and the time of the request and obey the order as quickly as possible.
- .2 The contractor shall advise the Departmental Representative within 24 hours of this delay to the progress of the work.

23 CONTACT WITH INMATES

- .1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any employee doing any of the above will be removed from the site and his security clearance revoked.
- .2 It is forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this contract.

END OF SECTION

1 REFERENCES

- .1 Government of Canada:
 - .1 Canada Labour Code - Part II.
 - .2 Canada Occupational Health and Safety Regulations.
- .2 American National Standards Institute (ANSI):
 - .1 ANSI A10.3-2006, – Safety Requirements for Powder-Actuated Fastening Systems
ANSI for Construction and Demolition Operations
- .3 Canadian Standards Association (CSA):
 - .1 CSA Z797-2009 Code of Practice for Access Scaffold.
- .4 HRSDC Fire Protection Engineering Section:
 - .1 FCC No. 301-1982, Standard for Construction Operations.
- .5 National Building Code of Canada (NBCC 2005):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites
- .6 Province of British Columbia Building Code (2006):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .7 Province of British Columbia:
 - .1 Workers Compensation Act Part 3 - Occupational Health & Safety.
 - .2 Occupational Health & Safety Regulations.

2 RELATED SECTIONS

- .1 Section 01 01 50 - General Instructions for; Submittals procedures, Section Temporary utilities, Construction facilities and Temporary barriers and enclosures.

3 WORKERS' COMPENSATION BOARD COVERAGE

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

4 COMPLIANCE WITH REGULATIONS

- .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
 - .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.
-

5 SUBMITTALS

- .1 Make submittals in accordance with Section 01 01 50 General Instructions for Submittals.
- .2 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by federal and provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .3 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative for review.
- .4 No work can start until the Health and Safety Plan has been submitted and approved.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

6 RESPONSIBILITY

- .1 Assume responsibility as the Prime Contractor for work under this contract and appoint a qualified coordinator for the purpose of ensuring the coordination of health and safety activities for the location in accordance with sections 118 and 119 of Part 3 of the Workers Compensation Act.
- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

7 HEALTH AND SAFETY COORDINATOR

- .1 The Health and Safety Coordinator (Registered Occupational Hygienist, Certified Industrial Specified Hygienist) must:
 - .1 Be responsible for completing all health and safety training, and ensuring that personnel
-

that do not successfully complete the required training are not permitted to enter the site to perform work.

- .2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
- .3 Be on site during execution of work.

8 GENERAL CONDITIONS

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
 - .2 Secure site after working hours in accordance with Section 01 14 10 - Security Requirements.

9 PROJECT/SITE CONDITIONS

- .1 Work at site will involve:
 - .1 Working in areas where inmates may be present who are under supervision by CSC staff. Conform to Security Requirements Section 01 41 10 Contact with Inmates clause and other security requirements pertaining to a CSC institution.

10 REGULATORY REQUIREMENTS

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

11 FILING OF NOTICE

- .1 Submit a Notice of Project, form 52E49, to WorkSafeBC in accordance with OH&S Regulation 20.2, at least 24 hours before start of work.
- .2 Submit copy to Departmental Representative.

12 HEALTH AND SAFETY PLAN

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations.
 - .3 Definition of responsibilities for project safety/organization chart for project.

- .4 General safety rules for project.
- .5 Job-specific safe work, procedures.
- .6 Inspection policy and procedures.
- .7 Incident reporting and investigation policy and procedures.
- .8 Occupational Health and Safety Committee/Representative procedures.
- .9 Occupational Health and Safety meetings.
- .10 Occupational Health and Safety communications and recordkeeping procedures.
- .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
- .3 List hazardous materials to be brought on site as required by work.
- .4 Indicate engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
- .5 Identify personal protective equipment (PPE) to be used by workers.
- .6 Identify personnel and alternates responsible for site safety and health.
- .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC). PWGSC's review shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

13 EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative.
 - .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
 - .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.
 - .3 Work with hazardous substances.
 - .4 Underground work.
-

14 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents in accordance with clause 5.2.4.

15 ELECTRICAL SAFETY REQUIREMENTS

- .1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
 - .1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.
 - .2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

16 ELECTRICAL LOCKOUT

- .1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.
- .3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

17 OVERLOADING

- .1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

18 FALSEWORK

- .1 Design and construct false work in accordance with CSA S269.1.

19 SCAFFOLDING

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 Code of Practice for Access Scaffold and BC Occupational Health and Safety Regulations.
-

20 CONFINED SPACES

- .1 Carry out work in confined spaces in compliance with provincial regulations.

21 POWDER-ACTUATED DEVICES

- .1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.

22 FIRE SAFETY AND HOT WORK

- .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
- .2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

23 FIRE SAFETY REQUIREMENTS

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

24 FIRE PROTECTION AND ALARM SYSTEM

- .1 Do not obstruct, shut-off or leave inactive at the end of a working day or shift, the fire protection and alarm systems.
- .2 Do not use fire hydrants for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department and the Departmental Representative, resulting from false alarms.

25 UNFORESEEN HAZARDS

- .1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

26 POSTED DOCUMENTS

- .1 Post legible versions of the following documents on site:
 - .1 Health and Safety Plan.
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
-

- .5 Notice of Project.
 - .6 Floor plan(s).
 - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
 - .9 Material Safety Data Sheets (MSDS).
 - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
-
- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
 - .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

27 MEETINGS

- .1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

28 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- .3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The Contractor will be responsible for any costs arising from such a "stop work order".

END OF SECTION

1 RELATED SECTIONS

- .1 Section 01 01 50 - General Instructions for training.
- .2 Division 22- Plumbing.
- .3 Division 23 - Heating, Ventilating and Air-Conditioning.
- .4 Division 25 - Integrated Automation (EMCS).
- .5 Division 26 - Electrical.
- .6 Division 28 - Electronic Safety and Security.

2 DEFINITIONS

- .1 Acronyms:
 - .1 Cx - Commissioning.
 - .2 EMCS - Energy Monitoring and Control Systems.
 - .3 O&M - Operation and Maintenance.
 - .4 PI - Product Information.
 - .5 PV - Performance Verification.
 - .6 TAB - Testing, Adjusting and Balancing.

3 QUALITY ASSURANCE

- .1 Testing organization: current member in good standing of AABC certified to perform specified services.
- .2 Comply with applicable procedures and standards of the certification sponsoring association.
- .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

4 REFERENCES

- .1 Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems.

5 SUBMITTALS

- .1 Submit test reports in accordance with Section 01 01 50 - General Instructions; Submittal Clause.
 - .2 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.
 - .3 Prior to start of Work, designate who has managerial responsibilities for coordination of entire testing and adjusting of electronic equipment.
 - .4 Submit documentation to confirm organization compliance with quality assurance provision.
-

- .5 Submit 3 preliminary specimen copies of each of report forms proposed for use.
- .6 Ten (10) days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.
- .7 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

6 PROCEDURES - GENERAL

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Notify Departmental Representative 3 days prior to beginning of operations.
- .3 Accurately record data for each step.
- .4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

7 CONTRACTOR'S RESPONSIBILITY

- .1 Prepare each system for testing and balancing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

8 PREPARTATION

- .1 Provide instruments required for testing and adjusting operations.
- .2 Make instruments available to Departmental Representative to facilitate spot checks during testing.
- .3 Test electronic system for proper operation and programming.

9 FINAL REPORTS

- .1 Reports to be completed by organization having managerial responsibility.
- .2 Ensure each form bears signature of recorder and his supervisor.

10 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in specified operating and program mode.
- .2 Complete Cx prior to issuance of Substantial Completion.
- .3 Cx deliverables have been submitted and accepted by Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 References - Federal Legislation
 - .1 Canadian Environmental Assessment Act (CEAA), 2012, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions].
- .2 Before proceeding with demolition of slab on grade and excavation adjacent to existing building and where required by authority having jurisdiction submit for review by Departmental Representative shoring and underpinning drawings prepared by qualified professional engineer registered or licensed in the Province of British Columbia, showing proposed method.
- .3 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Sections 01 01 50 - General Instructions and indicate:
 - .1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.
 - .2 Schedule of selective demolition.
 - .3 Number and location of dumpsters.
 - .4 Anticipated frequency of tippage.
 - .5 Name and address of haulers and waste receiving organizations.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

1.4 REGULATORY REQUIREMENTS

- .1 Comply with WCB Industrial Health and Safety Regulations and Canada Labour code Canada Occupational Safety and Health Regulations.

1.5 EXISTING CONDITIONS

- .1 Take over areas where demolition / removal work is indicated based on the condition at the time of examination prior to tendering.
- .2 Should unidentified Asbestos Containing Materials (ACM) or other hazardous substance encountered in course of removal work or cutting and boring activities, stop work, take preventive measures, and notify Departmental Representative immediately. Do not proceed until written instructions have been received from the Departmental Representative.
- .3 Unidentified hazardous material removal is additional work and will be paid either as an extra to the contract price in accordance with General Conditions, or removed under a separate contract by the Departmental Representative.
- .4 The existing building will be occupied and operational by the Institution during the work of this Contract. Maintain building access around protected work areas.

1.6 PROTECTION

- .1 Protect adjoining floor areas from migrating dust and fumes from work area.
- .2 At end of each day's work, leave work in safe and secure condition.
- .3 Clean up and remove debris and materials not being reinstalled.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 Prior to beginning work, inspect site, building and work areas with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage, storage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site and existing building in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal

and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

- .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
- .2 Immediately notify the Engineer should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PROTECTION

- .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.
- .2 Keep noise, dust, and inconvenience to occupants to minimum.
- .3 Protect building systems, services and equipment.
- .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
- .5 Protect adjoining floor areas from migrating dust and fumes from work areas.
- .6 At end of each day's work, leave work in safe and secure conditions. Clean up and remove debris and materials not being reinstalled.
- .7 Comply with WCB Industrial Health and Safety regulations, Canada Labour Code, Canada Occupational Safety and Health Regulations.
- .8 Do Work in accordance with Section 01 35 33 - Health and Safety Requirements.

3.3 SALVAGE

- .1 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .2 Remove items to be reused, store as directed by Departmental Representative, and re-install under appropriate section of specification.

3.4 SITE REMOVALS

- .1 Site Verification of Conditions:
 - .1 Investigate site and building to determine removal work, processing and storage logistics required prior to beginning of Work.
 - .2 Inspect work area with Departmental Representative to verify extent and location of items designated for removal and disposal and items to remain.
 - .3 Locate and protect building system. Preserve active systems in operating condition serving remainder of site and building.

- .2 Remove items as indicated and required.
- .3 Removal of Pavements, Curbs and Slabs:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Departmental Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials.

3.5 DEMOLITION

- .1 Remove parts of existing building site to permit new construction. Sort materials into appropriate piles for reuse and recycling.
- .2 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.6 CUTTING AND PATCHING

- .1 General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay:
 - .1 Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- .2 Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations:
 - .1 In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - .2 Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - .3 Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond core drill.
 - .4 Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - .5 Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - .6 Proceed with patching after construction operations requiring cutting are complete.
- .3 Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable

seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications:

- .1 Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- .2 Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
- .3 Floors and Walls: Where walls or partitions that are removed extend from one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, colour, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance:
 - .1 Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
- .4 Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
- .5 Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

3.7 DISPOSAL

- .1 Dispose of removed materials, to appropriate recycling facilities except where specified otherwise, in accordance with authority having jurisdiction.

END OF SECTION

1 General

1.1 RELATED WORK

- .1 Fire stopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers) and electrical assemblies (i.e. Inside cable trays) are specified in Division 22, 23, 26 and 27 respectively.

1.2 DESCRIPTION OF WORK

- .1 Apply firestop sealant and systems around all penetrations through openings in fire rated wall and ceiling assemblies.
- .2 Seal around ducts and conduits penetrating fire separations.

1.3 REFERENCES

- .1 ULC-S115-2005 Standard Method of Fire Tests of Firestop Systems.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 01 50.
- .2 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

2 Products

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with ULC-S115.
 - .1 Systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Fire stop system rating: to match wall/floor/roof assembly of one hour rating.
 - .2 Service penetration assemblies: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No. 40 U19.
 - .3 Prefabricated flange units, with outer metal flange die-stamped from 0.3 mm thick 316 stainless steel, with inset of premoulded silicone elastomeric ring, factory moulded, U.L.C. or W.H. listed as a through penetration fire stop. Flange hinged for fixing over pipe and then secured tight with self-tapping screw.
 - .4 Fire-resistance rating of installed fire stopping assembly not less than the fire- resistance rating
-

of surrounding wall assembly.

- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: prefabricated silicone elastomeric seal; do not use a cementitious or rigid seal at such locations.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

3 Execution

3.1 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

3.2 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Tighten self-tapping screw on flange unit to ensure adequate tight and permanent seal.

3.3 INSPECTION

- .1 Notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.4 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated walls and ceilings.
 - .2 Around mechanical and electrical assemblies penetrating fire separations.
 - .3 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.5 CLEAN UP

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 - Rough Carpentry.
- .2 Section 09 21 16 - Gypsum Board.
- .3 Section 09 22 16 - Non-Structural Metal Framing.
- .4 Section 09 51 00 - Acoustic Ceilings.
- .5 Section 09 65 16 - Resilient Sheet Flooring.
- .6 Mechanical.
- .7 Electrical.

1.2 DESCRIPTION OF WORK

- .1 Supply and installation of all equipment as specified below, in locations as indicated plans and Appendices. Include connections to all services provided by others.
- .2 Provide a proposed contract between supplier and Owner for maintenance of dental equipment.
- .3 Provide a quotation for maintenance of all equipment provided for a period of two (2) from date of occupancy of the facility.
- .4 Electrical and Mechanical trade contractors to provide primary services and make connections to appropriate installed healthcare equipment of the patient lift systems as shown on plans and as herein specified.
- .5 After installation, examine and test equipment under operating condition to determine that each component of the assembly has been installed correctly and functions properly.
- .6 Instruct Owner's representatives on proper operation and maintenance of the equipment.

1.3 SUBMITTALS

- .1 Submit manufacturer's product data in accordance with Section 01 01 50 - General Instructions.
 - .2 Submit shop drawings in accordance with Section 01 01 50 - General Instructions..
 - .3 Submit within 30 days of contract award, complete detailed shop drawings showing items in plan and elevation. Show dimensions and details of construction, supports, installation and interface to related services, which require cutting or close fitting.
-

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Deliver products and materials in accordance with the construction schedule.
- .2 Store to avoid damage.
- .3 Protect installed items against damage. Leave protective coverings in place until final clean-up.

1.5 WARRANTY

- .1 Provide manufacturer's written warranty covering repair service and replacement of defective parts on the following from date of Substantial Completion:
 - .1 One year warranty for any part of the healthcare equipment that fails as a result of material defect of workmanship.
 - .2 Extended warranty for any part of the healthcare equipment that fails as a result of material defect of workmanship as listed in Part 2.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

2 Products

2.1 HEALTHCARE EQUIPMENT TO BE RELOCATED BY CONTRACTOR.

- .1 Equipment as listed in List of equipment to be Relocated by Contractor, as indicated in Drawing A901 – Furniture and Equipment Layout Floor Plan, as described and specified in Medical Equipment Picture Inventory February 28, 2018 and Medical Equipment Cut Sheets, shall be relocated from existing Building 20a in Mission Minimum Institution from existing locations described in the List of Equipment.
- .2 Contractor to relocate healthcare equipment to new locations indicated in the Contract documents.
- .3 Confirm functioning conditions of all equipment prior to relocation.

2.2 HEALTHCARE EQUIPMENT TO BE RELOCATED AND INSTALLED BY CONTRACTOR.

- .1 Equipment as listed in List of equipment to be Relocated and Installed by Contractor, as indicated in Drawing A901 – Furniture and Equipment Layout Floor Plan, as described and specified in Medical Equipment Picture Inventory February 28, 2018 and Medical Equipment Cut Sheets, shall be relocated from existing Building 20a in Mission Minimum Institution from existing locations described in the List of Equipment.
-

- .2 Contractor to install healthcare equipment to ne locations indicated in the Contract Documents.
- .3 Mount and connect to mechanical and electrical services.
- .4 Confirm functioning conditions of all equipment being relocated.
- .5 Contractor to engage the following company and personnel to relocate all existing dental equipment and warrant its condition:

Susan Trask

National Institutional Strategic Accounts Manager



604-559-6944

1-866-568-8284

Cell 778-838-4452

susan.trask@henryschein.ca

2.3 HEALTHCARE EQUIPMENT TO BE PURCHASED AND INSTALLED BY CONTRACTOR.

- .1 Healthcare equipment as listed in List of Equipment to be Purchased and Installed by contractor, as indicated in Drawing A806 – Washroom and Equipment accessories, as described and specified in Medical Equipment Picture Inventory February 28, 2018 and Medical Equipment cut sheets, shall be purchased, put in place and mounted to new locations indicated in the Contract documents.

2.4 HEALTHCARE EQUIPMENT NOT TO BE RELOCATED

- .1 Healthcare equipment as listed in List of Equipment Not to be Relocated is to remain in existing locations.

3 Execution

3.1 INSTALLATION

- .1 Healthcare equipment hangers with mounting hardware and instructions included with the equipment delivery. Mounting hardware to seismic requirements of National Building Code Seismic Zone for Mission, BC.
 - .2 Install the healthcare equipment with mounting hardware and instructions furnished by manufacturer.
 - .3 Electrical Contractor to furnish and install conduit to the service boxes with wiring. Make connection of building services to prewired junction box as shown on the electrical drawings.
-

- .4 Mechanical Contractor to furnish and install plumbing services to locations required for dental equipment and make final connections.

3.2 TESTING AND DEMONSTRATION

- .1 Operate and test installed healthcare equipment to ensure proper operation. Adjust as required to ensure smooth operation and accurate positioning.
- .2 Demonstrate to Departmental Representative's designated representatives complete operation and required maintenance.

3.3 PROTECTION AND CLEAN-UP

- .1 Protect adjacent surfaces from damage during installation.
- .2 Protect items installed under this Section from damage resulting from the work of other Sections.
- .3 Promptly as the work proceeds and on completion remove all crating, wrapping, surplus materials and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 Reference Standards

- .1 Perform work in accordance with the recommendations and requirements of:
 - .1 National Fire Protection association, NFPA 10 – Standard for Portable Fire Extinguishers.
 - .2 National Building Code of Canada 2015.

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings and product data for the extinguishers and extinguisher cabinets.

1.4 Maintenance Data

- .1 Provide maintenance data for incorporation into the Mechanical Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 Products

- .1 FE-1 Recessed Cabinet with Extinguisher (finished areas):
 - .1 229 mm [9"] wide x 610 mm [24"] high x 152 mm [6"] deep cabinet
 - .2 full length semi-concealed piano hinges for 180 degree swing
 - .3 flush stainless steel door latch with no exposed fasteners
 - .4 22 gauge steel tub
 - .5 16 gauge steel door and trim with optional 5 mm clear tempered glass (-G-T)
 - .6 grey prime coated finish ready for field painting
 - .7 4.5 kg [10 lb.] ABC dry chemical multipurpose fire extinguisher
 - .8 Standard of Acceptance:
 - N.F.E. model CE-950-3-2-FR-G-T extinguisher cabinet

PART 3 EXECUTION

3.1 Installation

- .1 Install fire extinguishers in cabinets at locations as indicated on architectural drawings.
- .2 Coordinate locations of fire extinguisher cabinets with the framing trades in order to facilitate recessed and semi-recessed installations.
- .3 Mount fire extinguishers and cabinets such that the top of the extinguisher is at 1220 mm [4 feet] above the floor.
- .4 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in the cabinets prior to the project substantial completion review by the Departmental Representative.

3.2 Identification

- .1 Identify fire extinguishers in accordance with the recommendations of NFPA 10.
- .2 Attach a tag or label to all fire extinguishers, indicating the month and year of installation, with space for recording subsequent service dates.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
 - .1 ANSI/NFPA 13-2013, Installation of Sprinkler Systems.
 - .2 ANSI/NFPA 25-2014, 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).
- .4 Fire Commissioner of Canada FC 403, "Sprinkler System".

1.3 Samples

- .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.

1.4 Design Requirements

- .1 Design 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.
- .2 The "Authority Having Jurisdiction" is Fire Protection Engineering Services of Human Resources and Skills Development Canada (HRSDC).
- .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 sprinkler systems.
- .6 Design systems for earthquake protection for buildings in seismic zone applicable.

- .7 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.
- .8 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
- .9 Water Supply:
 - .1 Base hydraulic calculations on static and residual pressures indicated on drawings. For design purpose, the available water supply pressures shall be de-rated by a 10% safety factor.

1.5 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions.
 - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.
 - .2 Shop drawings: submit drawings stamped sealed and signed by professional engineer registered or licensed in Province of B.C. Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.
 - .7 Assembly details.
 - .8 Accessories.
- .3 Drawings: Sprinkler heads and piping system layout.
 - .1 Prepare detail working drawings of system layout in accordance with NFPA 13 using full size contract drawings.
 - .2 Show data essential for proper installation of each system.

- .3 Show details, plan view, elevations, and sections of systems supply and piping.
- .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.
 - .2 Indicate type and design density of each system.
- .3 Assurance of Professional Design and Commitment for Field Review.
 - .1 Provide Assurance commitment letters (Schedules B-1 and B-2) at the commencement of the project, in accordance with the building code and for Building Permit application.
 - .2 Provide Assurance of Professional Field Review and Compliance (Schedule C-B) at the completion of the project.
- .4 Closeout Submittals:
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 01 50 – General Instructions in accordance with ANSI/NFPA 20.
 - .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Sprinkler heads.
 - .3 Pipe hangers and supports.
 - .4 Mechanical couplings.
 - .3 Field Test Reports:
 - .1 Preliminary tests on piping system.
 - .2 Formal tests and inspections
 - .4 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings (prints) of each system for record purposes.
 - .2 Submit drawings in AutoCAD and PDF digital file versions with title block similar to full size contract drawings.
 - .5 Operation and Maintenance Manuals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

- .2 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual specified in Section 01 01 50 – General Instructions in accordance with ANSI/NFPA 13.

1.6 Quality Assurance

- .1 Qualifications:
 - .1 Installer: company or person specializing in sprinkler systems with documented experience.
 - .2 All work shall be carried out by Sprinkler Pipe Fitters who carry a "Certificate of Qualification" for this trade as issued by the B.C. Province Ministry of Labour.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.
- .3 Inspections and Tests:
 - .1 All inspections, examinations and tests required by the "Authorities and Agencies having jurisdiction" specified shall be arranged and paid for by the fire protection contractor, as necessary to obtain complete and final acceptance of the fire protection system.
 - .2 Provide Contractor's Material and Test Certificates and all required test papers as may be requested by all parties having jurisdiction and duly witnessed by Departmental Representative, showing proof of:
 - .1 Underground hydrostatic test of 1400 kPa (200 PSI).
 - .2 Flushing of underground main through 100mm (4") drain pipe.
 - .3 Hydrostatic test of overhead piping @ 1400 kPa (200 PSI).
 - .4 Verification of all alarm and trouble devices installed under this contract.
 - .3 Provide the services of the Professional Engineer who designed the fire protection systems for "Field Review" of the installation. Construction period review reports shall be submitted during the construction period.
 - .4 If welding is required, the Contractor shall submit a copy of the welder's certification to the Departmental Representative for record purposes prior to starting work.

1.7 Maintenance

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

- .2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

1.8 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Pipe, Fittings & Valves

- .1 Pipe:
 - .1 Piping shall meet or exceed one of the following standards:
 - .1 Black and Hot-Dipped Galvanized Welded and Seamless Steel Pipe – ASTM A795
 - .2 Welded and Seamless Steel Pipe – ANSI/ASTM A53
 - .3 Wrought Steel Pipe – ANSI B36.19M
 - .4 Elec.-Resistance Welded Steel Pipe – ASTM A135
 - .2 All thickness for pressures up to 2070 kPa (300 psi) shall be as follows:
 - .1 Joined by shop welding or roll grooving:
 - .1 Up to and incl. 125mm (5") – Schedule 10
 - .2 150mm (6") – 3.40mm (0.134)
 - .3 200mm, 250mm (8", 10") – 4.78mm (0.188")
 - .2 Joined by threaded fittings or cut grooves:
 - .1 up to 200mm (8") – Schedule 40
 - .2 200mm (8") and larger – Schedule 30
- .2 Fittings and joints to ANSI/NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .2 Copper tube: screwed, soldered, brazed.

- .3 System piping 50mm (2") and smaller shall be Schedule 40 and joined with threaded fittings in accordance with NFPA 13. Larger sizes shall be Schedule 10 and joined by welding or groove joining methods in accordance with NFPA 13.
 - .4 All grooved products shall be of one manufacturer. All grooved end fittings shall be of "full flow" design and manufactured from ductile iron conforming to ASTM A-536. Grooved coupling shall be designed with angle bolt pads to provide a rigid joint except where flexibility is required. "Flush cap" or "flush seal" gaskets shall be used with couplings in dry pipe systems.
 - .5 Cast iron floor and ceiling plates with set screws shall be provided whenever pipe passes through walls, floors and partitions. In finished areas, plates shall be chrome plated.
- .3 Valves:
- .1 ULC listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, O. S. & Y. gate.
 - .3 NPS 2 1/2 and over: cast iron, flanged or roll grooved ends, indicating butterfly valve; OS & Y gate.
 - .4 Swing check valves.
 - .5 Ball drip.
 - .6 All water supply and zone isolation valves shall be monitored with tamper switches. Electric wiring for control and alarm components will be provided Under Division 16.
 - .7 Valves controlling water supply and alarm shut-off shall be of O. S. & Y. type with rising stem or approved gear operated butterfly valves with supervisory switch. Where a grooved piping system is installed, grooved end isolation/control valves may be used. Valves shall be supervised by a factory installed double throw/double pole switch.
 - .8 All O. S. & Y. gate vales shall be monitored with tamper switches. Electric wiring for control and alarm components shall be provided under Division 16.
- .4 Pipe hangers:
- .1 ULC listed for fire protection services.
 - .2 Hanger standards shall conform to Section 3-10 of NFPA 13. Use "C" clamps complete with lock nuts and restraining straps. Hangers shall be supplied and installed in accordance with NFPA 13. C-type clamps used to attach hangers to the building structure shall be equipped with lock nuts and retaining straps.
 - .3 Sway bracing shall be installed as per Section 3-5.3.5 of NFPA 13.

2.2 Sprinkler Heads

- .1 General: to ANSI/NFPA 13 and ULC listed for fire services.
- .2 All sprinklers in suspended ceiling areas shall be chrome finish recessed type with chrome flush type escutcheon plates. All sprinklers in open ceiling areas shall be of brass finish upright or pendent types. All sidewall sprinklers shall be chrome finish horizontal type.

- .3 Sprinkler shall be protected from mechanical injury by standard guards where necessary. The proximity of sprinklers to heating units shall be taken into consideration in determining the temperature rating.
- .4 Adjacent to each sprinkler alarm valve, provide one (1) 12-sprinkler capacity Underwriters approved cabinet complete with various type and temperatures of sprinklers in ratio to the numbers installed of each type along with a standard sprinkler wrench.

2.3 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 Pressure or flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
 - .3 Connect into building fire alarm system.
 - .4 Connection of switch: Section 28 31 02 – Multiplex Fire Alarm System.

2.4 Pressure Gauges

- .1 Provide pressure gauges at the following locations:
 - dry pipe valve
 - compressor
 - pump suction and discharge
 - top of all standpipe risers
- .2 Pressure gauges shall be ULC listed stem mount or wall mount type with Bourdon phosphor bronze tube, brass socket, 6 mm [1/4"] lower connection, aluminum case in black enamel finish, chrome removable slip ring, stainless steel rotary type movement, minimum 90mm [3 1/2"] dial of 1% of full scale range and pressure range to suit application, with lever handle cock and brass 6 mm [1/4"] NPT snubber to suit service.

2.5 Flow Switches

- .1 Provide alarm indication for each system or zone indicated. Flow switches shall be vane-type with retard for pipes 50mm [2"] or larger; without retard for smaller pipe sizes.
- .2 All zones shall have a flow switch, an isolation valve and an integral test and drain.

2.6 Pipe Sleeves

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

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- .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with [plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
 - .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
 - .6 Sleeves in Other than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61 mm thick galvanized steel sheet.

2.7 Escutcheon Plates

- .1 Provide split hinged type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished chromium-plated finish on copper alloy plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.8 Spare Parts Cabinet

- .1 For storage of maintenance materials, spare sprinkler heads and special tools.
- .2 Construct to sprinkler head manufacturer's standard.

2.9 Inspector's Test Connection

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.10 Signs

- .1 Attach properly lettered 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.

PART 3 EXECUTION

3.1 Manufacturer's Instruction

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

3.2 Above Ground Piping Systems

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- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
 - .2 Perform welding in shop; field welding will not be permitted.
 - .3 Conceal piping in areas with suspended ceiling.

3.3 Pipe Installation

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.
- .5 Install spare parts cabinet as indicated.
- .6 Valve identification:
 - .1 Identify drain valve and auxiliary valves.

3.4 Field Painting

- .1 Clean, pre-treat, prime, and paint new systems including piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 mil, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 mil.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Piping in Finished Areas:
 - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
 - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
 - .3 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.
 - .2 Piping in Unfinished Areas:
 - .1 Finish painting not required in spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces

where walls or ceiling are not painted or not constructed of a pre-finished material.

- .2 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.5 Field Quality Control

.1 Site Test, Inspection:

- .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
- .2 Test, inspect, and approve piping before covering or concealing.
- .3 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable 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 corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests 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 tests and approve systems before they are accepted.
 - .7 Altered and relocated sprinkler system to be inspected and tested in conformance with NFPA 125.

3.6 Placing In Service

- .1 When the entire fire protection system has been completed to the satisfaction of the Departmental Representatives and when operating and maintenance instructions have been provided, the Fire Protection Contractor shall, in the presence of the

Departmental Representative, demonstrate the complete operation and maintenance required to the operating personnel. A complete operational test conducted on the entire installation for the purpose of verification of compliance with all applicable standards and codes shall be carried out.

- .2 Three copies of a complete operating manual shall be provided, which must include the following:
 - .1 Detailed instructions for the normal maintenance of all installed equipment including operational procedures, frequency of operational checks, service instructions and trouble shooting instructions.
 - .2 Valve schedule for all valves including location, service type and normal position for all systems.
 - .3 Schematic showing the location of each excess pressure pump breaker, inspectors test valves, low point drains and flow switches where applicable.
 - .4 Warranties and certificates.
 - .5 Manufacturer's operating and maintenance manuals.
 - .6 Description of the operation of each system and the function of each piece of equipment.
 - .7 Lubrication schedule for all lubricated equipment including recommended lubricants.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|-------------------------------|
| .1 | Section 01 01 50 | General Instructions |
| .2 | Section 23 05 05 | Installation of Pipework |
| .3 | Section 23 07 19 | Thermal Insulation for Piping |

1.2 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 A 307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .2 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .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.
- .5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .6 National Sanitation Foundation (NSF).
 - .1 NSF 61, Drinking Water System Components.

1.3 Submittals

- .1 Submittals in accordance with Section 01 01 50 - General Instructions.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.6 Quality Assurance

- .1 All potable water system components shall conform to NSF Standard 61.

PART 2 PRODUCTS

2.1 Piping

- .1 Domestic hot, cold and hot recirculation water systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M to NPS 4 size.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.
- .2 Water service pipe NPS6 or large in building shall be Ductile Iron, minimum Pressure Class 350 designed and manufactured in accordance with ANSI/AWWA C150/A21.50 and C151/A21.51. All pipe shall be cement –mortar lined in accordance with ANSI/AWWA C104/A2.4 and grooved to BS 4772/2531 standards.
- .3 Underground water supply piping 100mm [4"] or larger shall be AWWA C900 PVC pressure pipe with compatible fittings. Provide concrete thrust blocks for joint restraint at changes of pipe direction.

2.2 Fittings

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 to NPS 4: roll grooved to CSA B242.
- .6 NPS 6 and larger: fittings shall be British Standard/ISO cement-mortar lined and bituminous coated ductile iron fittings conforming to ASTM A-536 with Grade "M" Flushseal gaskets suitable for a temperature range of 20°F to + 200°F.

2.3 Joints

- .1 Rubber gaskets, 1.6mm thick: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 tin copper alloy or brazing.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 Gate Valves

- .1 NPS2 and under, soldered:
 - .1 Rising stem: to MSSSP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .2 NPS2 and under, screwed:
 - .1 Rising stem: to MSSSP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .3 NPS2-1/2 and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSSSP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS & Y bronze trim.
- .4 NPS2-1/2 and over, other than mechanical rooms, flanged:
 - .1 Non-rising stem: to MSSSP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet.

2.5 Globe Valves

- .1 NPS2 and under, soldered:
 - .1 To MSSSP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.
 - .2 Lockshield handles: as indicated.

- .2 NPS2 and under, screwed:
 - .1 To MSSSP-80, Class150, 1MPa, bronze body, screwed over bonnet, renewable composition disc.
 - .2 Lockshield handles: as indicated.

2.6 Swing Check Valves

- .1 NPS 2 and under, soldered:
 - .1 To MSSSP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.
- .2 NPS2 and under, screwed:
 - .1 To MSSSP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.
- .3 NPS2-1/2 and over, flanged:
 - .1 To MSSSP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap.

2.7 Ball Valves

- .1 NPS2 and under, screwed:
 - .1 Class150.
 - .2 Bronze body, chrome plated brass ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle.
- .2 NPS2 and under, soldered:
 - .1 To ANSI B16.18, Class150.
 - .2 Bronze body, chrome plated brass ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

2.8 Drain Valves

- .1 Drain valves shall be provided with cap and chain.
- .2 Drain and hose valves 20mm (3/4") and smaller:
 - .1 Sediment Faucets.
 - .2 Ball valves.

2.9 Plumbing Piping

- .1 Water supply piping under concrete slabs or in walls shall be encased in standard weight flexible polyethylene pipe one size larger than copper tubing. All joints to be wrapped in plastic wrapping tape.

2.10 Dielectric Unions

- .1 Insulating dielectric unions and flange unions shall be installed when adapting between dissimilar metallic pipe for domestic water supply piping, and domestic

water storage tanks. Elsewhere, unions and adaptors for copper piping shall be cast brass pressure fittings.

2.11 Expansion Joints

- .1 Domestic and industrial water: Annular close pitch corrugated metal hose with Type 316L stainless steel butt welded tube. Type 304 single stainless steel outer brain, flanged, welded or screwed ends. Suitable for 1034 kPa (150 psi) working pressure and 50mm traverse.

2.12 Strainers

- .1 NPS 2 and under: Full pipeline size, 250 lb. SWP bronze, with screwed ends and a removable plug type screen retainer.
- .2 NPS 2-1/2 and over: Full pipeline size, 250 lb. SWP semi-steel, with flanged ends and a bolted screen retainer.

PART 3 EXECUTION

3.1 Installation

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Install CWS piping below and away from HWS and HWR and all other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.
- .7 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .8 When grooved fittings are used, contractors shall provide proof of training on site by the mechanical coupling manufacturer, or manufacturer's representative prior to the start of installation.

3.2 Valves

- .1 Isolate equipment, fixtures and branches with gate 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 Test pressure: greater of 1 times the maximum system operating pressure or 860 kPa.

3.4 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.

3.5 Disinfection

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

3.6 Performance Verification

- .1 Timing: Starts after:
 - .1 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 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize HWS and HWR systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 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 re-charge air chambers. Repeat for outlets and flush valves.
 - .7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results for Mechanical
- .3 Section 23 05 05 Installation of Pipework

1.2 References

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 32, Specification for Solder Metal.
 - .2 ASTM B 306, Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564, 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.

1.3 Submittals

- .1 Submittals in accordance with Section 01 01 50 - General Instructions.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Copper Tube and Fittings

- .1 Above ground sanitary storm and vent, Copper Type DWV to: ASTM B 306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: tin-lead, 50:50, type 50A or lead free, tin-copper alloy 95:5, type TA to ASTM B 32.

2.2 Cast Iron Piping and Fittings

- .1 Buried sanitary storm and vent, cast iron (minimum NPS 2) to: CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.
 - .2 Stainless steel clamps.
 - .2 Above ground sanitary storm and vent: Cast iron to CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 ABS Piping

- .1 Drainage piping under the building, provided that such piping does not pass through any fire separations, may be as follows, at the contractor's option:
 - .1 Underground sanitary drainage piping under building, 150mm in diameter and smaller shall be certified to the current version of CSA B181.1, ABS Drain, Waste and Vent Pipe and Fittings. Piping shall be solid wall in construction. Cell core piping is not acceptable.

PART 3 EXECUTION

3.1 Installation

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

- .3 Install buried pipe on 150 mm bed of clean washed sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with 150 mm of clean washed sand.
- .4 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

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.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 01 91 00 Commissioning
- .4 Section 22 42 01 Plumbing Specialties and Accessories
- .5 Section 23 05 00 Common Work Results for Mechanical
- .6 Section 23 05 48 Vibration & Seismic Controls for Ductwork, Piping and Equipment

1.2 References

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
 - .3 CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Household Service.
 - .4 CAN/CSA-C309-M90 (R2014), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .2 National Sanitation Foundation (NSF) / American National Standards Institute (ANSI).
 - .1 NSF/ANSI 61, Drinking Water System Components.

1.3 Submittals

- .1 Submittals in accordance with Section 01 01 50 – General Instructions.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.

- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.6 Quality Assurance

- .1 All potable water system components shall conform to NSF/ANSI Standard 61.

PART 2 PRODUCTS

2.1 Gas-Fired Condensing Domestic Hot Water Storage Heater

- .1 General: Floor-mounted, gas fired, condensing, fully modulating, storage domestic hot water heater. Power vent, direct ignition.
- .2 Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code.
- .3 Boiler/burner package to bear ULC, CGA label.
- .4 Features:
 - .1 Maximum hydrostatic working pressure of 1103 kPa (160 psi).
 - .2 Powered anodes that are non-sacrificial and maintenance free.
 - .3 Seamless glass-lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded.
 - .4 Foam insulation and CSA Certified and AMSE rated T&P relief valve.
 - .5 Down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up.
 - .6 Approved for 0mm (0") clearance to combustibles.
 - .7 Integrated solid-state temperature and ignition control devise with integral diagnostics, graphic user interface fault history display, digital temperature readout, leak detection, remote monitoring from a secure web site that automatically notifies selected personnel via email and/or cellular phone text messages if operational problems or user defined Alert Conditions occur. Hardware is compatible with BACnet compliant supervisory controls and connected to the building management system.
- .9 Venting: direct vent sealed combustion. Hot water heater to complete with direct-vent conversion kit, and flue gas backflow preventer. Provide concentric venting kit where indicated.
 - .1 Combustion air intake:
 - .1 Where direct vent is specified, provide system 636 CPVC intake piping.
 - .2 Venting pipe shall be system 636 CPVC piping. Grey (high temperature) shall be used.
 - .2 The chimney must be designed by a chimney manufacturer including all connector pieces, roof flashing, storm collar, and condensate drain connections.

- .3 CPVC BH Class II 90°C Flue Gas Venting pipe, fittings and termination kits shall meet or exceed performance standards set by the American Society of Testing and Materials (ASTM), Underwriters' Laboratories of Canada (ULC S636) and CSA B149.1 (Section 8.9.6).
- .4 Pipe, fittings, and solvent weld cement components of CPVC BH Class II 90°C Flue Gas Venting System has been tested and approved by a certified Testing Agency as a system and thus only pipe and fittings provided by that manufacturer should be used in an installation. Mixing of components made by other manufacturers should not be made.
- .5 Appliance Adapters supplied by the appliance manufacturer are permitted provided the appliance adapter complies with ULC-S636 and is compatible with vent systems specified by the appliance manufacturer. This standard recognizes that the appliance adapter of the venting system can be supplied by the appliance manufacturer rather than the manufacturer of the vent system.
- .6 A vent termination supplied by the appliance manufacturer is permitted provided the vent termination complies with ULC S636 and is compatible with vent systems specified by the appliance manufacturer. This standard recognizes that a vent termination of the venting system can be supplied by the appliance manufacturer rather than the manufacturer of the vent system.
- .7 Combustible and Non Combustible piping that penetrates a fire separation shall be sealed at the penetration by a fire stop system that, when subjected to the fire test method in ULC-S115, "Fire Tests of Firestop Systems," (Combustible piping must be tested with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side) has an FT rating not less than the fire-resistance rating of the fire separation.
- .8 CPVC venting pipe, and fittings shall be installed in full compliance with all provincial and local jurisdictional codes, standards and requirements. When used in non-combustible construction, high-rise buildings and air plenums, CPVC venting pipe shall be tested and listed in accordance with CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not more than 25 and a smoke-developed classification not exceeding 50. Contact manufacturer for specific details and restrictions.
- .10 Condensate Handling System:
 - .1 The system shall include a condensate neutralizing system that is gravity drain and self actuating. The neutralizing system shall utilize calcium carbonate (limestone) as its neutralizing agent. The neutralizing system shall be sized to provide one heating season's of neutralizing capacity.
 - .2 The system shall neutralize the acidic condensate to a pH level that is safe for copper piping, building concrete, and the city sewer system.
 - .3 The condensate system (tank/container) must be easily removable with the use of flexible couplings and unions. Do not bolt down condensate system.

2.2 Electric Domestic Hot Water Heater

- .1 General: Automatic, electric, tank-type domestic hot water heater. To CAN/CSA C22.2 No.110, CAN/CSA-C191.
- .2 Electric potable water heater shall be designed and constructed to ANSI/ASME Boiler and Pressure vessel Code and require a CRN issued by the Boiler and Pressure Vessel Safety Branch.

- .3 Tank: heavy blanket insulation with baked enamel finish sheet metal lagging.
- .4 Heater: bronze immersion.
- .5 Features:
 - .1 Anti-siphon inlet.
 - .2 Powered anode corrosion protection.
 - .3 Pressure and temperature relief valve. Pipe valve to drain. Install sensing bulb in tank water.
 - .4 Electronic water heater control with animated icons that display detailed operational and diagnostic information, including element failure, low water cutoff, and BACnet compatible connected to building management system.

PART 3 EXECUTION

3.1 Installation

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Pipe relief valve to floor drain.
- .3 Install unions to permit removal or replacement of equipment.
- .4 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.
- .5 Pipe vertical condensate drain from flue vent to floor drain. Drain pipe shall be silicone hose. Install condensate trap (loop) per installation instruction and prime trap.
- .6 Provide vacuum breaker to CSA B64-01 as specified in Section 22 42 01 – Plumbing Specialties and Accessories.
- .7 CPVC Flue Gas Venting System is to be installed as outlined in the installation manual supplied by the manufacturer. This installation manual is in compliance with the requirements of ULC Standard S636 "Standard for Type BH Gas Venting Systems" and thus has been approved by INTERTEK / Warnock Hersey or other approved testing agency during the certification process.
- .8 Do not install piping with glued joints at temperatures below those recommended by solvent manufacturer.
- .9 CPVC Flue Gas Venting Systems must accommodate any expansion/contraction movement and stresses that may occur. Follow all manufactures recommendations.
- .10 Manufacturer's representatvie shall provide on-site inspection during installation, ensuring proper installation and procedures are followed.

3.2 Field Quality Control

- .1 Commissioning:
 - .1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.
 - .2 Manufacturer to:
 - .1 Certify installation.
 - .2 Start up and commission installation.
 - .3 Carry out on-site performance verification tests.

- .4 Demonstrate operation and maintenance.
- .3 Provide Departmental Representative at least 48 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.3 Cleaning

- .1 Proceed in accordance with Section 01 01 50 – General Instructions, and Section 23 08 02 – Cleaning & Startup of Mechanical Piping Systems.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Specialties and Accessories.
- .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 Related Section

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results for Mechanical
- .3 Section 23 08 01 Performance Verification Mechanical Piping Systems

1.3 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
- .3 Canadian Standards Association (CSA)
 - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
 - .2 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Plumbing and Drainage Institute (PDI)
 - .1 PDI-WH201, Water Hammer Arresters Standard.
- .5 National Sanitation Foundation (NSF).
 - .1 NSF 61, Drinking Water System Components.

1.4 Submittals

- .1 Submittals in accordance with Section 01 01 50 - General Instructions.
- .2 Indicate, for all plumbing specialties and accessories:
 - .1 Dimensions, construction details, roughing-in dimensions.

1.5 Closeout Submittals:

- .1 Submit maintenance data in accordance with Section 01 01 50 – General Instructions.
- .2 Include:
 - .1 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.6 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.7 Delivery Storage and Disposal

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 01 50 – General Instructions.
 - .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
 - .3 Fold up metal banding, flatten and place in designated area for recycling.

1.8 Quality Assurance

- .1 All potable water system components shall conform to NSF Standard 61.

PART 2 PRODUCTS

2.1 Cleanouts

- .1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access covers:
 - .1 Wall access: face or wall type, polished nickel bronze or stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top cast box with anchor lugs and:

- .1 Plugs: bolted bronze with neoprene gasket.
- .2 Cover for unfinished concrete floors: cast iron round gasket, vandal-proof screws.
- .3 Cover for terrazzo finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws
- .4 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
- .5 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.2 Water Hammer Arrestor

- .1 Copper construction, bellows type: to PDI-WH201.

2.3 Back Flow Preventer

- .1 To CSA-B64 Series.
- .2 Application: as indicated.

2.4 Vacuum Breaker

- .1 To CSA-B64 Series.

2.5 Pressure Regulator

- .1 Capacity and performance:
- .2 Up to NPS1-1/2 bronze bodies, screwed: to ASTM B 62.
- .3 NPS2 and over, semi-steel bodies, Class 125, flanged: to ASTM A 126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

2.6 Trap Seals Primer

- .1 Brass, with integral vacuum breaker, NPS1/2 solder ends, NPS1/2 drip line connection.

2.7 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.
- .3 NPS2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.8 Hose Bibbs and Sediment faucets

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.9 Circulation Pumps

- .1 Provide circulating pumps where indicated, designed for quiet operation and guaranteed by the manufacturer for the intended operation.
- .2 Hot water circulating pumps shall be suitable for pumping 100°C water.
- .3 All pumps shall be fitted with mechanical shaft seals.
- .4 Domestic water pumps shall be all bronze construction.

2.10 Piping Freeze Protection Systems

- .1 Complete CSA approved system of heaters and components, listed specifically for maintaining freeze protection for insulated piping at ambient to -40°C.
- .2 The self-regulating heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in self-regulating polymer core specially designed for this application that varies its heat output all along its length, allowing the heater to maintain the water in the selected temperature range. The resistance shall be less than the heating cable bus wire resistance as determined in a type test per ASTM B193. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
- .3 The heater shall operate on a single phase line voltage as noted.
- .4 Provide power connection, end seal, splice, tee components and required accessories for field installation.

PART 3 EXECUTION

3.1 Installation

- .1 Install in accordance with Canadian Plumbing Code provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 Cleanouts

- .1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.
- .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.

3.3 Water Hammer Arrestor

- .1 Install on branch supplies to each fixture or group of fixtures and where indicated.

3.4 Back Flow Preventers

- .1 Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain and/ or service sink.

3.5 Hose Bibbs and Sediment Faucets

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

3.6 Trap Seal Primers

- .1 Install for all floor drains and elsewhere, as indicated
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Departmental Representative.
- .3 Install soft copper or plastic tubing to floor drain.

3.7 Piping Freeze Protection Systems

- .1 Install self-regulating heater and components on rainwater leaders, water supply piping mains and risers as indicated in the plans and specifications after the piping has been pressure tested, but before the thermal insulation is applied. Secure the heater to piping with Raychem GT-66 fiberglass tape.
- .2 Apply "electric traced" signs to the outside of the thermal insulation.
- .3 After installation and before and after installing the thermal insulation, test heater using a 1000 VDC megger. Minimum insulation resistance should be between 20 and 1000 megaohms regardless of length.
- .4 Power connection to heater shall be provided by Division 26. Arrange with electrical contractor to perform and certify the megger test.

3.8 Performance Verification:

- .1 General:
 - .1 In accordance with Section 23 08 01 – Performance Verification Mechanical Piping Systems.
- .2 PV procedures:
 - .1 Vacuum breakers, backflow preventers: operation under all conditions.
 - .2 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

PART 1 GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 The supply and installation of Plumbing 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 Related Section

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results for Mechanical

1.3 References

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45, Plumbing Fixtures.
 - .2 CAN/CSA-B125, Plumbing Fittings.
 - .3 CAN/CSA-B651, Barrier-Free Design.
- .2 National Sanitation Foundation (NSF).
 - .1 NSF 61, Drinking Water System Components.

1.4 Submittals

- .1 Submittals in accordance with Section 01 01 50 - General Instructions.
- .2 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.

1.5 Closeout Submittals:

- .1 Submit maintenance data in accordance with Section 01 01 50- General Instructions.

- .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.

1.6 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.7 Delivery Storage and Disposal

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 01 50 – General Instructions.
 - .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
 - .3 Fold up metal banding, flatten and place in designated area for recycling.

1.8 Quality Assurance

- .1 All potable water system components shall conform to NSF Standard 61.

PART 2 PRODUCTS

2.1 Manufactured Units

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass shall be chrome plated finish. Water supply piping exposed in finished areas shall be chrome plated brass pipe and fittings.
- .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.
- .7 Fixture Schedule:

WC-1 Accessible Water Closet with Sensor Flush Valve

'ELONGATED' Toilet, wall hung, vitreous china, antimicrobial surface which inhibits the growth of stain and odor causing bacteria, mold and mildew, elongated syphon jet flush action bowl, 2-1/8" (54mm) fully glazed internal trapway, 10" x 12" (254mm x 305mm) large water surface, high efficiency 4.2 LPF (1.1 GPF) to low consumption 6 LPF (1.6 GPF), 1-1/2" (38mm) top spud with condensate channel, for use with exposed flush valve. (Minimum MaP Test Rating: 1000 grams.) Electronic 'No Touch' Flush Valve Unit, C.P. low consumption 6.0 LPF (1.6 GPF), factory set flow, quiet action, diaphragm type with filtered by-pass, infrared proximity sensor and

courtesy flush over-ride button, solenoid flush controller, circuitry, S.S. wall access plate, vacuum breaker, seat bumper and back-check angle stop. Power requirement 5VA. Mount sensor to clear toilet seat. Transformer, 120/24 VAC 50 VA. Toilet Seat, elongated heavy duty solid plastic open front with cover, with reinforced stainless steel check hinge, posts, washers and nuts. Single Horizontal Carrier, with block base feet, bolts, cap nuts, adjustable nipple, gasket, test plug and protection cap. 'Heavy Weight' Couplings, MJ couplings, constructed of extra wide 4 to 6 band corrugated type 304 stainless steel bands, with heavy duty worm drive clamps. Provide 4" (102mm) square electric boxes in wall for solenoid and sensor mounting.

L-1 Accessible Lavatory with Sensor Faucet

S.S. Basin, three hole 4" (102mm) centers, 19" x 23-1/2" x 5-5/8" (480mm x 600mm x 140mm) deep, wall hung, 18 Ga. (1.2mm), grade 18-8 type 304 stainless steel, satin finish, integral overflow, with side wall brackets and wall hanger bracket. Stainless Steel Semi-Pedestal, to cover exposed piping as per local codes. Electronic 'No Touch' Faucet, Hard-Wired C.P. 4" (102mm) C.C., solid cast brass body with integral proximity sensor, with vandal-resistant 1.9 LPM (0.5 GPM) flow spray outlet, control module, solenoid, strainer, 43°C (109°F) tempered water supplied by thermostatic mixing valve with back checks and service stops housed in 12" (305mm) Sq. recessed metal box with 13" (330mm) Sq. V.P. S.S. face, located in wall under basin. Flexible conduit from control module to faucet and solenoid provided. Power requirement 15 VA. Provide tee, adaptors and flexible copper tubing to suit installation. Transformer, 120/24 VAC 50 VA. Basin Drain, C.P., cast brass 1 pc. top, offset open grid with 17ga. (1.5mm), 1-1/4" (32mm) tailpiece. Provide S.S. Supply with escutcheon (to connect box to faucet). 'p' Trap, C.P., polished, cast brass adjustable body, 1-1/4" (32mm) with cleanout plug, seamless brass wall bend and escutcheon. Sanitary covering, of PVC, vandal-resistant flexible seamless construction, anti-microbial, to exposed piping (to protect against heat/contusions) as per local codes.

S-1 Single Basin Counter Mounted Sink

S.S. Sink, 3 hole, 8" (203mm) centers, 20-9/16"x 20-1/8" x 7" (522mm x 511mm x 178mm) deep, counter mounted, back ledge, grade 18-8 type 302 stainless steel, single compartment, satin finished rim and bowl, self-rimming, 1-1/2" (38mm) tailpiece, sound deadening and mounting kit, 3-1/2" (89mm) crumb cup strainer with 1-1/2" (38mm) tail piece. Faucet, C.P. 8" (203mm) C.C., deck mounted, solid cast brass lead-free body, 1/4 turn ceramic disc valve cartridges, 9" (229mm) long swing spout with vandal-resistant, 5.7 LPM (1.5 GPM) flow laminar outlet and cast brass 4" (102mm) blade handles. Thermostatic mixing valve, lead free brass body construction, tamper resistant locking nut, built-in check valves and strainer, under counter 4-port body, set max. temperature at 49°C (120°F). Supplies, C.P., polished brass, rigid horizontal nipples 3/8" (9.5mm) x 3" (75mm) long I.P.S., heavy all brass angle stops with V.P. loose key, escutcheons, and flexible copper risers. 'P' trap, C.P. polished cast brass adjustable body, 1-1/2" (38mm) with cleanout plug, seamless brass wall bend and escutcheon.

S-2 Double Basin Counter Mounted Sink

S.S. Sink, 3 hole, 8" (203mm) centers, 15-13/16" x 29-1/4" x 7" (400mm x 740mm x 178mm) deep, counter mounted, back ledge, 18GA. (1.2mm) grade 18-10 type 304 stainless steel, double compartment, satin finished rim and bowl, self-rimming, with crumb cup strainers 1-1/2" (38mm) tailpiece, located center back, sound deadening and mounting kit, 3-1/2" (89mm) crumb cup strainer with 1-1/2" (38mm) tail piece.

Faucet, C.P. 8" (203mm) C.C., deck mounted, solid cast brass lead-free body, 1/4 turn ceramic disc valve cartridges, 9" (229mm) long swing spout with vandal-resistant, 5.7 LPM (1.5 GPM) flow laminar outlet and cast brass 4" (102mm) blade handles. Thermostatic mixing valve, lead free brass body construction, tamper resistant locking nut, built-in check valves and strainer, under counter 4-port body, set max. temperature at 49°C (120°F). Supplies, C.P., polished brass, rigid horizontal nipple 3/8" (9.5mm) x 5" (127mm) long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and flexible copper risers. 'P' trap, C.P. polished cast brass adjustable body, 1-1/2" (38mm) with cleanout plug, seamless brass wall bend and escutcheon.

S-3 Single Basin Counter Mounted Sink with Under Counter Interceptor

S.S. Sink, 3 hole, 8" (203mm) centers, 20-9/16"x 20-1/8" x 7" (522mm x 511mm x 178mm) deep, counter mounted, back ledge, grade 18-8 type 302 stainless steel, single compartment, satin finished rim and bowl, self-rimming, 1-1/2" (38mm) tailpiece, sound deadening and mounting kit, 3-1/2" (89mm) crumb cup strainer with 1-1/2" (38mm) tail piece. Faucet, C.P. 8" (203mm) C.C., deck mounted, solid cast brass lead-free body, 1/4 turn ceramic disc valve cartridges, 9" (229mm) long swing spout with vandal-resistant, 5.7 LPM (1.5GPM) flow laminar outlet and cast brass 4" (102mm) blade handles. Thermostatic mixing valve, lead free brass body construction, tamper resistant locking nut, built-in check valves and strainer, under counter 4-port body, set max. temperature at 49°C (120°F). Supplies, C.P., polished brass, rigid horizontal nipples 3/8" (9.5mm) x 3" (75mm) long I.P.S., heavy all brass angle stops with V.P. loose key, escutcheons, and flexible copper risers. 305mm diameter x 305mm high sediment interceptor, all duco coated steel, 1-1/2" (38mm) drain and escutcheon. 4 1/2" (114 mm) clearance above interceptor for basket removal.

S-4 Existing Single Basin Counter Mounted Sink

Existing oval basin mounted in dental cabinet that is relocated. See medical equipment drawings for more information. Existing sink faucet deck mounted, relocated with existing dental cabinet and sink. Provide all necessary trim for relocated sink, including the following items. Provide thermostatic mixing valve, lead free brass, body construction, tamper resistant locking nut, built-in check valves and strainer, under counter 4-port body, set max. temperature at 49°C (120°F). Install valves recessed in wall in a security type access box (0.90mm galv. Frame with back mounting flange and front reinforcing hemmed edge) 305mm x 305mm c/w type 304 stainless steel cover secured with vandal-resistant screws. Provide basin drain, C.P., cast brass 1 pc. top, open grid less overflow holes and 17ga. (1.5mm), 1-1/4" (32mm) tailpiece with double gasket. (Provide supplies) C.P., polished brass, rigid horizontal nipple 3/8" (9.5mm) x 5" (127mm) long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and flexible copper risers. Provide 'p' Trap, C.P., polished, cast brass adjustable body, 1-1/4" (32mm) with cleanout plug, seamless brass wall bend and escutcheon.

FD-1 Floor Drain

Floor Drain, all duco coated, 9" (220mm) dia. cast iron body, reversible flashing clamp with seepage openings, no-hub outlet, round strainer with twenty-eight (28) 10mm diameter holes equally spaced radially, vandal-proof screws for penal application, trap primer connection 1/2" (13mm).

FD-2 Floor Drain

Floor Drain, all duco coated cast iron body, reversible flashing clamp with seepage openings oval Funnel (8-1/4" x 3-1/4") , trap primer connection 1/2" (13mm) , vandal Proof Screws.

RD-1 Roof Drain

Roof Drain, all duco coated 12" (305mm) cast iron body, flashing clamp with seepage openings , sump receiver, underdeck clamp, extension solid (height to suit roof construction), aluminum dome, waterproofing flange to be provided by contractor.

TP Trap Primer

Electronic trap primer with solenoid actuating device, vacuum breaker, water hammer arrestor and necessary electrical hardware; adjustable frequency and duration of priming and distribution splitter for multiple priming.

TMV-1 Thermostatic Mixing Valve

Exposed valve shall be a combination thermostatic and pressure-balanced mixing valve, with a liquid-filled motor. In the event of interruption of hot or cold water supply, or thermostat failure, the valve shall be designed to restrict flow by use of a sliding piston control mechanism with a reverse seat closure. The valve shall maintain output temperature for changes in inlet pressure and temperature. Valve construction shall have bronze body and finish with stainless steel piston and liner. Mixing valve shall include a union end stop and check valve with removable strainer on each 19mm (3/4") inlet. Includes dial thermometer and shut off valve on tempered water 19mm (3/4") outlet. ASSE lead free certified. Capacity of 37.8 litres/minute (10 USgpm) at 69 kPa (10 psi) pressure drop.

PART 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 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.
- .2 All gaps between fixtures, wall and floors are to be sealed with acrylic caulking compound.

3.2 Supplies

- .1 Provide isolation valves or stops for every fixture or appliance connection.
- .2 Provide water hammer arrestors for flush valves and solenoid controlled appliances.

3.3 Adjusting

- .1 Conform to water conservation requirements specified this section.

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

3.4 Performance Verification:

- .1 PV procedures:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
 - .3 Wash fountains: operation of flow-actuating devices.
 - .4 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|---------------------------|
| .1 | Section 01 01 50 | General Instructions |
| .2 | Section 01 91 00 | Commissioning |
| .3 | Section 23 05 05 | Installation of Pipework |
| .4 | Section 23 05 54 | Mechanical Identification |

1.2 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 A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .2 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA Z7396.1, Medical Gas Pipeline Systems.
- .4 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 01 50 – General Instructions.
- .2 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 Close-out Submittals

- .1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.
- .2 Data to include:
 - .1 Description of system and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.5 Quality Assurance

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 Waste Management Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Piping

- .1 Laboratory vacuum piping:
 - .1 Above ground: copper tube, hard drawn, type K: to ASTM B 88M up to NPS 4 size.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.

2.2 Fittings

- .1 All fittings for connecting copper tubing shall be wrought copper, brass or bronze fittings made especially for brazed connection, except as provided in the following sentence. Brass piping shall be assembled with screw type brass fittings or with bronze or copper brazing type fittings.
- .2 All joints in the piping, except those permitted to be approved brass flared type gas tubing fittings and those at valves or at equipment requiring screw connections shall be made with silver brazing alloy or similar high melting point (at least 1000 °F) brazing metal..
- .3 Screw joints used in shut off valves, including station outlet valves, shall be installed by tinning the male thread with soft solder. Litharge and glycerin or an approved oxygen luting or sealing compound is acceptable.

2.3 Valves

- .1 Valves shall be of bronze body, double seal, full port, union ball-type with Teflon (TFE) seats and Viton seals, "O" ring packing, bronze ball which seals in both directions, blow-out proof stem, having a pressure rating of 2758 kPa (400 psig).
- .2 Valves shall be operated by a lever handle requiring only a quarter turn from a fully open position to a fully closed position. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port to facilitate installation.
- .3 Valves shall be designed so that it can be "swung-out" during installation to prevent damage due to heat transfer during the brazing operation. A UL listed label showing the appropriate gas services and pressure rating shall be attached to each valve.
- .4 Valves shall be ULC and CRN Listed.

PART 3 EXECUTION

3.1 Installation

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Install identification in accordance with Section 23 05 54 – Mechanical Identification, supplemented as specified herein.
- .3 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .4 Assemble all piping using fittings manufactured to ANSI standards.
- .5 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .6 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.

3.2 Valves

- .1 Isolate equipment, fixtures and branches with gate or ball valves.
- .2 Valves shall be designed so that it can be "swung-out" during installation to prevent damage due to heat transfer during the brazing operation. A UL listed label showing the appropriate gas services and pressure rating shall be attached to each valve.

3.3 Disinfection

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Departmental Representative.

3.3 Field Quality Control

- .1 Testing and certification of installation will be completed by a certified testing agency and will meet CSA Z7396.1.

3.4 Reports

- .1 In accordance with Section 01 91 00 – Commissioning.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|---------------------------|
| .1 | Section 01 01 50 | General Instructions |
| .2 | Section 01 91 00 | Commissioning |
| .3 | Section 23 05 05 | Installation of Pipework |
| .4 | Section 23 05 54 | Mechanical Identification |

1.2 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 A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .2 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA Z7396.1, Medical Gas Pipeline Systems.
 - .3 CSA Standard CAN/CSA-Z305.4 Certification of installation.
- .4 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .5 National Fire Protection Association.
 - .1 NFPA 99 - Standard for Health Care Facilities.

1.3 Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 01 50 – General Instructions.

- .2 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 Close-out Submittals

- .1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.
- .2 Data to include:
 - .1 Description of system and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.5 Quality Assurance

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.
- .2 Comply with Federal, Provincial, and Local Codes applicable to this installation. All equipment to be CSA approved and labelled.

1.6 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 Waste Management Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Piping

- .1 Dental air piping:
 - .1 Above ground: copper tube, hard drawn, type K: to ASTM B 88M up to NPS 4 size.
 - .2 Distribution system piping shall be washed and degreased, seamless copper tubing, provided with protective caps at both ends. Where concealed, it shall be soft temper and where exposed, it shall be hard temper. Piping shall not be supported by other piping but shall be supported with pipe hangers suitable for the size of pipe, and of proper strength and quality at proper intervals, so that piping cannot be moved accidentally from the installed position as follows:

- 1/2 inch (12) pipe or tubing.....6 feet (1.8m)
- 3/4 inch (20) or 1 inch (25) pipe or tubing.....8 feet (2.4m)

- .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.

2.2 Fittings

- .1 All fittings for connecting copper tubing shall be wrought copper, brass or bronze fittings made especially for brazed connection, except as provided in the following sentence. Brass piping shall be assembled with screw type brass fittings or with bronze or copper brazing type fittings.
- .2 All joints in the piping, except those permitted to be approved brass flared type gas tubing fittings and those at valves or at equipment requiring screw connections shall be made with silver brazing alloy or similar high melting point (at least 1000°F) brazing metal..
- .3 Screw joints used in shut off valves, including station outlet valves, shall be installed by tinning the male thread with soft solder. Litharge and glycerin or an approved oxygen luting or sealing compound is acceptable.

2.3 Valves

- .1 Valves shall be of bronze body, double seal, full port, union ball-type with Teflon (TFE) seats and Viton seals, "O" ring packing, bronze ball which seals in both directions, blow-out proof stem, having a pressure rating of 2758 kPa (400 psig).
- .2 Valves shall be operated by a lever handle requiring only a quarter turn from a fully open position to a fully closed position. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port to facilitate installation.
- .3 Valves shall be designed so that it can be "swung-out" during installation to prevent damage due to heat transfer during the brazing operation. A UL listed label showing the appropriate gas services and pressure rating shall be attached to each valve.
- .4 Valves shall be ULC and CRN Listed.

PART 3 EXECUTION

3.1 Installation

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Install identification in accordance with Section 23 05 54 – Mechanical Identification, supplemented as specified herein.
- .3 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

- .4 Assemble all piping using fittings manufactured to ANSI standards.
- .5 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .6 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.
- .7 After installation of station outlet valves, each section of the piping system shall be subjected to a test pressure of one and one-half times maximum working pressure, but in no case less than 150 psi, by means of oil-free (water-pumped) nitrogen or air. This test pressure shall be maintained until each joint has been examined for leakage by means of soapy water. All leaks shall be repaired and the section re-tested.
- .8 A 24-hour standing pressure test with oil-free (water-pumped) nitrogen or air at one and one-half times maximum working pressure, but in no case less than 150 psi, shall be made to check the completeness of joint tests. After completion of the final standing pressure test, the system shall be thoroughly flushed with the gas to be used in the system to assure the removal of all nitrogen or air.

3.2 Valves

- .1 Isolate equipment, fixtures and branches with gate or ball valves.
- .2 Valves shall be designed so that it can be "swung-out" during installation to prevent damage due to heat transfer during the brazing operation. A UL listed label showing the appropriate gas services and pressure rating shall be attached to each valve.

3.3 Disinfection

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Departmental Representative.

3.3 Field Quality Control

- .1 Testing and certification of installation will be completed by a certified testing agency and will meet CSA Z7396.1.

3.4 Reports

- .1 In accordance with Section 01 91 00 – Commissioning.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Read Division 1 General Requirements in conjunction with these specifications. Division 1 and this section shall form a part of and shall apply to all Mechanical Sections. The most stringent requirements of this and other Mechanical Sections must be adhered to.
- .2 The Mechanical work shall consist of the supply and installation of complete and operable mechanical systems and shall include all necessary labour, plant, materials, and incidentals for the work involved as listed in the following division sections:
 - .1 Section 21 Fire Suppression
 - .2 Section 22 Plumbing
 - .3 Section 23 Heating Ventilation & Air Conditioning

1.2 Submittals

- .1 Submittals: in accordance with Section 01 01 50 – General Instructions.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 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.
- .4 In addition to transmittal letter referred to in Section 01 01 50 - General Instructions: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative 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 performance verification test results.
 - .2 Special performance data as specified.
 - .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .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 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .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 Departmental Representative for approval and make corrections as directed.
- .4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

1.3 Regulations

- .1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and this specification. Practices contained in these standards or standards suggested or recommended by reference organizations, are to be taken as minimum requirements.
- .2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.
- .3 The "Authority Having Jurisdiction" is Fire Protection Engineering Services of Human Resources and Skills Development Canada (HRSDC).
- .4 Drawings and specifications should not conflict with these Regulations but where there are apparent discrepancies, notify the Departmental Representative in writing and obtain clarifications before proceeding with the work.

1.4 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Definitions

- .1 Definitions used in this Division will have the following meaning:
 - .1 "Concealed": pipes, ducts, etc., in trenches, chases, furred spaces, pipe shafts, or hung ceilings.
 - .2 "Exposed": regarding insulation and painting of piping, ducts, etc., will mean that they are not "concealed", as defined herein.
 - .3 "Piping": includes, in addition to pipe, all fittings, valves, hangers, other accessories which comprise a system.
 - .4 "Provide": to supply and install, complete and ready for use.

1.6 Drawings

- .1 Drawings:
 - .1 Are not intended to show structural details or architectural features.
 - .2 Are not to be scaled.
 - .3 Except where dimensioned, indicate general mechanical layouts only.
- .2 Provide field (shop) drawings to indicate relative position of various services when required by Departmental Representative and obtain approval before commencing work.

1.7 Maintenance

- .1 Furnish spare parts in accordance with Section 01 01 50 – General Instructions as indicated in the detailed product specification clauses.
- .2 Provide access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance.
- .3 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

1.8 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 Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Access Doors

- .1 Access door size shall be as indicated and where not indicated, make 305mm x 406mm [12" x 16"] minimum or 610mm x 457mm [24" x 18"] where persons have to enter. For acoustical ceilings, conform to architectural panel pattern.
- .2 Unless otherwise indicated, access doors shall be hinged, flush type, steel framed panel, 14 gauge minimum, satin finished galvanized steel or type 304 stainless steel, with anchor straps for wet areas, washrooms, and all walls finished in ceramic tile.
- .3 Hinges shall be concealed, spring hinge to allow door to open 175°. Locking devices shall be flush cam type, master key operated, doors and frames shall have prime coated rust inhibiting paint, unless made of stainless steel.
- .4 Where doors are required in fire rated walls, access doors shall be uninsulated and for all fire rated ceilings and walls where maximum temperature rise limitation is applicable, shall be insulated. All fire rated access doors shall have Warnock Hersey or ULC listed 2 hour fire rating and shall be installed in accordance with NFPA 80 and manufacturer's installation instructions.

PART 3 EXECUTION

3.1 Co-ordination

- .1 Co-ordinate work with work of other sections to avoid conflict.
- .2 Locate distribution systems, equipment, and materials to provide minimum interferences and maximum usable space.
- .3 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials, regardless of installation sequence.

3.2 Cleaning

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

3.3 Cutting and Patching

- .1 Make arrangements with General Contractor for all cutting and patching in this work.
- .2 Minimize cutting and patching. Set sleeves and mark openings in concrete or masonry.

3.4 Waterproofing

- .1 Where any work pierces waterproofing including waterproofing concrete, the method of installation shall be as approved by the Departmental Representative before the work is done. Supply and install all necessary sleeves, caulking, roof curbs, and flashing required and make the openings watertight.

3.5 Protection of Work

- .1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Clean and return to "as new" condition.
- .2 Mask or grease and cover machined surfaces. Firmly secure covers over equipment openings and open ends of piping, conduit and ductwork as work progresses. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- .3 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative, using equal quality materials.

3.6 Field Quality Control

- .1 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Where specified, 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.

3.7 Demonstration

- .1 Departmental Representative 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 and as-built drawings as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections, but shall in no way be less than four (4) hours for the plumbing systems, four (4) hours for the mechanical systems (with the EMCS training time specified separately) and four (4) hours for the fire protection systems.

END OF SECTION

PART 1 GENERAL

1.1 Use of Systems

- .1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the 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 filters, which shall be inspected daily, changed every week or more frequently as required.
 - .6 Return systems have approved filters over all openings, inlets, outlets.
 - .7 All systems will be:
 - .1 operated as per manufacturer's recommendations or instructions.
 - .2 operated by Contractor.
 - .3 monitored continuously by Contractor.
 - .8 Warranties and guarantees are not thereby relaxed.
 - .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
 - .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.
- .2 Filters referred to herein are over and above those specified elsewhere in this specification.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.

PART 2 PRODUCTS

2.1 Not Used

- .1 Not Used.

PART 3 EXECUTION

3.1 Not Used

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical
- .3 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, Ready-Mixed Organic Zinc-Rich Coating.

1.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Not Used

- .1 Not Used

PART 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.

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, or components.

3.3 Pipework Installation

- .1 Protect openings against entry of foreign material.
- .2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .6 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 chain operators on valves NPS 2-1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .7 Install dielectric coupling between dissimilar metals.

3.4 Sleeves

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25mm above finished floor.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .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.

3.5 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.

3.6 Cleaning of Piping Systems

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.7 Pressure Testing of Equipment and Pipework

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .6 Conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1, Energy Code for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)
- .3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

- .1 Electrical work to conform to Division 26 including the following:
 - .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .2 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 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

1.5 Closeout Submittals

- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 01 50 - General Instructions.

1.6 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 General

- .1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 Motors

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.
- .3 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 °C, 3 phase, 208V, unless otherwise specified or indicated.

2.3 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 specified.
- .3 For motors under 7.5 kW 10HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10HP 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 to be 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.

2.4 Drive 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 tops and bottoms.
 - .3 38mm 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.

PART 3 EXECUTION

3.1 Installation

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

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 01 91 00 Commissioning
- .3 Section 23 05 00 Common Work Results – Mechanical
- .4 Section 23 05 13 Common Motor Requirements for HVAC Equipment
- .5 Section 23 08 00 Commissioning of Mechanical Systems

1.2 References

- .1 ANSI/UL 508 Industrial Control Equipment
- .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)
- .3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

- .1 Electrical work to conform to Division 26 including the following:
 - .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .2 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 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

1.5 Closeout Submittals

- .1 Provide maintenance data for motors, drives and guards for incorporation into the manual specified in Section 01 01 50 - General Instructions.

1.6 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.7 Warranty:

- .1 The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

PART 2 PRODUCTS

2.1 General

- .1 Furnish complete Variable Frequency Drives (VFD's), as specified herein, for mechanical equipment where noted on drawings, equipment schedules, or specifications.
- .2 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.
- .3 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor de-rating.
- .4 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- .5 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- .6 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.
- .7 The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.
- .8 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated

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- current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- .9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without de-rating.
- .10 An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- .11 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
- .12 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
- .13 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs, not including either galvanic or optical isolation on both analog I/O and discrete I/O, shall include additional isolation modules.
- .14 VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- .15 Interface Features:
- .1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.
- .2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.
- .3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.
- .16 Bypass:
- .1 Provide a manual 3-contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.

- .2 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

PART 3 EXECUTION

3.1 Installation

- .1 Install per manufacturer's instructions.
- .2 Install required safety labels.

3.2 Start-up Service

- .1 The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
- .2 Commissioning:
 - .1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

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

1.2 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical
- .3 Section 23 05 53 Mechanical Identification

1.3 References

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40. Grade 1A, 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 Submittal

- .1 Submittals in accordance with Section 01 01 50 – General Instructions.
- .2 Submit shop drawings and product data.

1.5 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.6 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.
- .2 Collect, separate and place in designated containers for packaging 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.

PART 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, digital, variable angle type.
 - .1 Display: LCD, operate on 35 lux of illumination. No external power needed. Display in Celsius or Fahrenheit with switch.
 - .2 Casing: High impact ABS plastic.
 - .3 Stem: adjustable angle.
 - .4 Socket: comply with industrial standard dimension, fully interchangeable with liquid-in-glass thermometers.

2.3 Thermometer Wells

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

2.4 Pressure Gauges

- .1 100 mm [4.0"] dial type: to ASME B40.100, Grade 1A, phosphor bronze bourdon tube having 1.0% accuracy full scale unless otherwise specified.
 - .1 Casing: Stainless Steel.
 - .2 Reading: S.I., or S.I./Imperial.
 - .3 Range: indicate mid-scale under normal operating conditions.
- .2 Provide:
 - .1 Snubber for pulsating operation.
 - .2 Diaphragm assembly for corrosive service.
 - .3 Gasketed pressure relief back with solid front.
 - .4 Bronze stop cock.

PART 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. Provide heat conductive material inside well.

- .2 Install in locations as indicated.
- .3 Install wells as indicated for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 Pressure Gauges

- .1 Install in locations as indicated.
- .2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical
- .3 Section 23 05 48 Vibration & Seismic Control for Ductwork, Piping and Equipment

1.2 References

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - .1 Seismic Restraint Manual, Guidelines for Mechanical Systems.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME):
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Plumbing Code.

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 building structure.
 - .4 Design hangers and supports to support systems under all 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 to be in accordance with MSS SP58.
- .2 Performance Requirements:
- .1 Design supports and hangers to withstand seismic events as specified Section 23 05 48 – Vibration & Seismic Control for Ductwork, Piping and Equipment.

1.4 Submittals

- .1 Submittals: in accordance with Section 01 11 00 - Shop Drawings, Product Data & Samples.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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 Section 01 01 50 – General Instructions.

1.5 Quality Assurance

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.6 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .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 and recycling in accordance with Section 01 01 50 – General Instructions.

PART 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 or epoxy coated.
- .2 Upper attachment:
 - .1 Concrete:
 - .1 Inserts for cast-in-place concrete: galvanized steel wedge. ULC listed for pipe NPS 3/4 through NPS 8 - Grinnell/Anvil Fig. 281.
 - .2 Carbon steel plate with clevis for surface mount: malleable iron socket with expansion case and bolt. Minimum two expansion cases and bolts for each hanger – Grinnell/Anvil, plate fig. 49, socket fig. 290, expansion case fig. 117.
 - .2 Steel Beam (bottom flange):
 - .1 Cold piping NPS 2 and under: malleable iron C clamp - Grinnell/Anvil fig. 61.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: malleable iron beam clamp - Grinnell/Anvil fig. 292.
 - .3 Steel Beam (top):
 - .1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp - Grinnell/Anvil Fig. 61.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer - Grinnell/Anvil fig. 227.
 - .4 Steel Joist:
 - .1 Cold piping NPS 2 and under: steel washer plate with double locking nuts.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket - Grinnell/Anvil: washer plate, fig. 60; clevis, fig. 66; socket, fig. 290.
 - .5 Steel Channel or Angle (bottom):
 - .1 Cold piping NPS 2 and under; malleable iron C clamp - Grinnell/Anvil fig. 86.

- .2 Cold piping NPS 2-1/2 and larger and all hot piping; universal channel clamp - Grinnell/Anvil fig. 226.
- .6 Steel Channel or Angle (top):
 - .1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp - Grinnell/Anvil fig. 61.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer - Grinnell/Anvil fig. 227.
- .7 Wood beam or ceiling:
 - .1 Ceiling plate and flanges: malleable iron – Grinnell/Anvil Fig. 128R.
 - .2 Eye socket: galvanized steel – Grinnell/Anvil fig. 189 or 190.
- .3 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.
- .4 Pipe attachments: material to MSS SP58.
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .5 Hanger rod attachment: material to MSS SP58.
 - .1 Use expansion anchor on existing concrete structure.
- .6 Adjustable clevis: material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

PART 3 EXECUTION

3.1 Installation

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems per Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations. Supporting piping from underside of light weight roof deck (without concrete) is not permitted.

3.2 Hanger Spacing

- .1 HVAC piping: in accordance with table below.

- .2 Plumbing piping: in accordance with the most stringent requirements of the table below as well as the following:
 - .1 National. Plumbing Code.
 - .2 Authority Having Jurisdiction.
- .3 Pipe hanger rods shall be sized in accordance to SMACNA Seismic Restraint Manual based on Seismic Hazard Level (SHL). For SHL, see Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

MAXIMUM HANGER SPACING						
PIPE DIA. NPS	STEEL SCH.40	COPPER L,K Hard Drawn	CAST.I STD.	GLASS	ABS/PVC	PEX
1/2	1.8 m [6'-0"]	1.8 m [6'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
3/4 & 1	2.4 m [8'-0"]	2.4 m [8'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
1-1/4	2.4 m [8'-0"]	3.0 m [10'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
1-1/2 & 2	2.4 m [8'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]		1.2 m [4'-0"]	0.8 m [2'-6"]
2-1/2, 3, 4 & 5	2.4 m [8'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]	2.4 m [8'-0"]	1.2 m [4'-0"]	0.8 m [2'-6"]
6 & 8	3.0 m [10'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]	2.4 m [8'-0"]	1.2 m [4'-0"]	0.8 m [2'-6"]

3.3 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.

3.4 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 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 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.

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33737 Dewdney Trunk Road, Mission, B.C.
EXPANSION OF HEALTH CARE**

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HANGERS & SUPPORTS FOR PIPING
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END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .3 Section 23 05 00 Common Work Results – Mechanical

1.2 References

- .1 National Building Code of Canada (NBC)
- .2 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - .1 Seismic Restraint Manual, Guidelines for Mechanical Systems.

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.
- .2 Provide vibration isolation systems shop drawings complete with performance and product data. Shop drawings shall demonstrate compliance with the National Building Code and shall bear the seal of a Professional Engineer.
- .3 Provide detailed drawings of all seismic restraint systems for ductwork, piping and equipment.

1.4 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 Vibration Isolation System – General

- .1 Performance of vibration isolation systems shall be designed by manufacturer specializing in vibration isolation materials and devices.
- .2 Size and shape of bases type shall be coordinated with submitted equipment.
- .3 Products shall of the same manufacturer unless otherwise noted.

2.2 Elastomeric Pads

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm [3/8"] minimum thick; 50 durometer; maximum loading 350 kPa [50 psi].

- .2 Type EP2 - rubber waffle or ribbed; 9 mm [3/8"] minimum thick; 30 durometer natural rubber; maximum loading 415 kPa [60 psi].
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm [3/8"] minimum thick neoprene bonded to 1.71 mm [16 gauge] steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa [50 psi].
- .4 Type EP4 - rubber-steel-rubber; 9 mm [3/8"] minimum thick rubber bonded to 1.71 mm [16 gauge] steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa [60 psi].

2.3 Hangers

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° 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, cup with molded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

2.4 Acoustic Barriers for Anchors and Guides

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

2.5 Flexible Pipe Connectors

- .1 Inner corrugated hose: stainless steel.
- .2 Outer braid: Braided wire mesh stainless steel outer jacket.
- .3 Type of end connection: threaded for 50mm [2"] or smaller; flange for 65mm [2-1/2"] or larger.
- .4 Operating conditions:
 - .1 Working pressure: 1379 kPa [200 psi].
 - .2 Working temperature: 4540 °C [850 °F].

2.6 Seismic Control Measures

- .1 General:
 - .1 Design anchorage and attachment methods for all systems and/or equipment as specified herein.
 - .2 Seismic control systems to work in all directions.
 - .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.
- .8 For equipment mounted on housekeeping pad, specify the minimum distance between anchor bolt and edge of housekeeping pad.
- .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Seismic restraints:
 - .1 Cushioning action to be gentle and steady.
 - .2 Shall never reach metal-like stiffness.
- .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Provide seismic restraints in addition to vibration isolation system to resist complete isolator unloading.
- .4 Piping systems:
 - .1 Provide seismic restraints for all piping in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:
 - .1 All compressed air piping NPS 1 or larger.
 - .2 Seismic restraints may be omitted for the following conditions:
 - .1 All piping suspended by individual hangers 305mm [12"] or less in length, as measured from the top of the pipe to the bottom of the structural support for the hanger.
 - .3 To be compatible with requirements for anchoring and guiding of piping systems.
 - .4 Wet weight of piping shall be to be used for designing seismic restraint systems.
 - .5 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .6 Where cable is used for restraining vibration isolated piping systems, install cable with sufficient slack to avoid short-circuiting of vibration isolators.
- .5 Ductwork systems:
 - .1 Provide seismic restraints for all ductwork in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:
 - .1 All rectangular ducts with cross sectional areas 0.56m² [6 ft²] and larger.
 - .2 All round ducts with diameters 711 mm [28"] and larger.

- .2 Seismic restraints may be omitted for the following conditions:
 - .1 All ductwork suspended by hangers 305mm [12"] or less in length, as measured from the top of the duct to the bottom of the structural support for the hanger.
- .6 Bracing methods:
 - .1 Approved by Departmental Representative.
 - .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.

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 Seismic control measures to meet requirements of NBC.
- .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 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 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 Provide the services of the Professional Engineer(s) who designed the restraint systems for "Field Review" of the installed components, and submit the following to the Departmental Representative:
 - .1 Assurance commitment letter, signed and sealed; provided at the commencement of the project.
 - .2 Signed and sealed shop drawings of seismic restraints for equipment, piping and ductwork; provided prior to installation.
 - .3 Typewritten inspection reports; provided during the construction period.
 - .4 Schedule C-B, signed and sealed; provided after performing "Field Review".

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 Submittals

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 01 50 – General Instructions.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 01 50 - General Instructions.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 Quality Assurance

- .1 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Delivery, Storage, and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

- .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 and recycling in accordance with Section 01 01 50 – General Instructions.
 - .2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.
 - .3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

PART 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:

	<u>Sizes (mm)</u>	<u>No. of Lines</u>	<u>Height of Letters (mm)</u>
1	10 x 50	1	3
2	13 x 75	1	5
3	11 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	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 Identification for the Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .1 Main identifier: Size #9.
 - .2 Source and Destination identifiers: Size #6.
 - .3 Terminal cabinets, control panels: Size #5.
 - .3 Equipment elsewhere: Sizes as appropriate.

2.3 Piping Systems Governed by Codes

- .1 Identification:
 - .1 Natural gas and propane: to CSA/CGA B149.1.
 - .2 Sprinklers: to NFPA 13.

2.4 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] [vinyl] with protective over-coating, 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 Departmental Representative.
 - .2 Colours for legends, arrows: to following table:

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

- .3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Hot water heating supply	Yellow	HEATINGSUPPLY
Hot water heating return	Yellow	HEATINGRETURN
Domestic hot water supply	Green	DOM.HWSUPPLY
Domestic HW recirculation	Green	DOM.HWCIRC
Domestic cold water supply	Green	DOM.CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN.VENT
Natural gas and propane	to Codes	
Fire protection water	Red	FIREPROT.WTR
Sprinklers	Red	SPRINKLERS

2.5 Identification Ductwork Systems

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 Valves, Controllers

- .1 Plastic tags with 12 mm stamped identification data.
- .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.

2.7 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.

2.8 Language

- .1 Identification in English.

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 Timing

- .1 Provide identification only after painting has been completed.

3.3 Installation

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to the PMSS.

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.

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

END OF SECTION

PART 1 GENERAL

1.1 General

- .1 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 Company

- .1 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed five projects of similar size and scope
- .2 All work shall be performed by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review by the Departmental Representative prior to work being carried out.

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 installed equipment and systems so as 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 installed 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 be to satisfaction of authority having jurisdiction.
- .2 TAB of existing equipment already in operation.

1.5 Co-Ordination

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as 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.
- .2 Review specified standards and report to Departmental Representative in writing all 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 Departmental Representative for verification of TAB reports.

1.9 Start of TAB

- .1 Notify Departmental Representative 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 weather-stripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere Division 23.
 - .4 All 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 Isolating and balancing valves installed open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 Application Tolerances

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.
 - .2 Hydronic systems: plus or minus 10%.

1.11 Accuracy Tolerances

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 Instruments

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be 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 Departmental Representative.

1.13 Submittals

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 Preliminary TAB Report

- .1 Submit for checking and approval of Departmental Representative 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 to be in accordance with Associated Air Balance Council Manual.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit a digital PDF version and six (6) copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 Verification

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 Settings

- .1 After TAB is completed to satisfaction of Departmental Representative, 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. Markings not to be eradicated or covered in any way.

1.18 Completion of TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 Air Systems

- .1 Standard: TAB to be to most stringent of this section or TAB standards of ASHRAE.
- .2 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dew point, duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .3 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .4 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 Domestic Hot Water Systems

- .1 Meet requirements as specified for liquid systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

1.21 Other TAB Requirements

- .1 Air terminal units:
 - .1 Check individually for correct operation and factory calibration of air volumes at "maximum" and "minimum" settings. Where calibration or

adjustment is found to be necessary it shall be carried out as part of the balancing procedure. The mechanical contractor and the Departmental Representative shall be informed of the extent of recalibration required.

- .2 Testing of Fire Dampers & Fire Stop Flaps:
 - .1 Conduct a "trip" test on all fire dampers and fire stop flaps to ensure that fire mechanisms function correctly and that dampers attain a fully closed position when tripped.
 - .2 Send a copy of test results tabulating the fire damper location, size, and date of trip test, to the Departmental Representative for record purposes. Copies shall also be inserted in Equipment Maintenance Manuals.
 - .3 Dampers and Flaps which fail to function correctly shall be re-tested after corrective action has been completed. Any fusible links damaged when conducting tests shall be replaced by this Contractor. A signed and dated test label shall be attached to each fire damper upon completion of test and resetting of fire damper.

1.22 CAD Drawings

- .1 CAD drawing files of the heating and ventilating tender drawings will be made available to the Balancing Contractor if requested. An "Authorization to use CAD Drawing File" agreement restricting the use of the CAD files to the preparation of the project balancing reports must be signed prior to obtaining the files.

PART 2 PRODUCTS

2.1 Not Used

- .1 Not used.

PART 3 EXECUTION

3.1 Not Used

- .1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results - Mechanical
- .3 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; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C 921, 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.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 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 defined herein.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.4 Submittals

- .1 Submittals: in accordance with Section 01 01 50 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.
- .4 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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.

1.5 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 Section 01 35 33 - Health & Safety 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 Section 01 01 50 – General Instructions.
 - .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 and recycling in accordance with Section 01 01 50 – General Instructions.
 - .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 Departmental Representative.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 Insulation

- .1 Mineral fibre as specified herein 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 C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this Section.
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this section.
 - .1 Mineral fibre: to ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C 553.
- .5 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Jackets

- .1 Canvas:
 - .1 [220] gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: Compatible with insulation.
- .2 Aluminum foil laminate:
 - .1 Multi-layer aluminum foil laminate; highly puncture and resistant, non-permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.
 - .2 Total thickness: 0.20 mm.
 - .3 Substrate thickness: 0.15 mm sheet.
 - .4 Finish: Aluminum, stucco embossed.
 - .5 Adhesive: cold weather acrylic adhesive.

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 C 449.
- .4 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .6 Contact adhesive: quick-setting

- .7 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.
- .8 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Pre-Installation Requirement

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry and free from foreign material.

3.3 Installation

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 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.
- .7 All ductwork exposed to weather shall have waterproof seams for weathertight construction. Exposed, ducts which are not insulated or finish painted, shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion.

3.4 Duct Insulation Schedules

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular, cold, dual temperature supply air ducts	C-1	Yes	50
Round, cold, dual temperature supply air ducts	C-2	Yes	50
Rectangular, warm air ducts	C-1	No	25
Round, warm air ducts	C-2	No	25
Supply, return and exhaust ducts exposed in space being served			None
Outside air ducts to mixing plenum	C-1	Yes	25
Exhaust ducts between dampers and louvers	C-1	No	25
Rectangular ducts outside	C-1	Special	50
Round ducts outside	C-2	Special	50
Acoustically lined ducts			None

.2 Finish: 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
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.5 Cleaning

- .1 Proceed in accordance with Section 01 01 50 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results - Mechanical
- .3 Section 23 05 05 Installation of Pipe Work.
- .4 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; Energy Standard for Buildings except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - .6 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .7 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning characteristics of Building Materials and Assemblies.

1.3 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 defined herein.
- .2 TIAC Codes:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 Submittals

- .1 Submittals: in accordance with Section 01 01 50 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.
- .4 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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.

1.5 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 Section 01 35 33 - Health & Safety 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 Section 01 01 50 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labeled 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 and recycling in accordance with Section 01 01 50 – General Instructions.
 - .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 Departmental Representative.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 Insulation

- .1 Mineral fibre as specified herein 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 C 335.
- .3 TIAC Code A-1: Rigid molded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Maximum "k" factor: to CAN/CGSB-51.9.

- .4 TIAC Code A-3: Rigid molded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.9.
- .5 TIAC Code C-2: Mineral fibre blanket faced [with] [without] 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: flexible closed-cell elastomer to ASTM C534.
 - .2 Jacket: to CGSB 51-GP-52Ma. Required for outdoor application.
 - .3 Maximum "k" factor: 0.27.
 - .4 Vapour transmission: 0.08 perm-inch.
 - .5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.
- .7 To be formaldehyde free, low VOC; resists mold and mildew.
- .8 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Insulation Securement

- .1 Tape: Self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: Stainless steel, 19mm wide, 0.5mm thick.

2.4 Cement

- .1 Thermal insulating and finishing cement:
 - .1 To CAN/CGSB-51.12.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.5 Vapour Retarder Lap Adhesive

- .1 Water based, fire retardant type, compatible with insulation.

2.6 Indoor Vapour Retarder Finish

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 Outdoor Vapour Retarder Finish

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m.

2.8 Jackets

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece molded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
 - .2 Colours: White.
 - .3 Minimum service temperatures: 20 °C [68 °F].
 - .4 Maximum service temperature: 65 °C [150 °F].
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Canvas:
 - .1 220 and 120 gm/m cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum foil laminate
 - .1 Multi-layer aluminum foil laminate; highly puncture and resistant, non-permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.
 - .2 Total thickness: 0.20 mm.
 - .3 Substrate thickness: 0.15 mm sheet.
 - .4 Finish: Aluminum, stucco embossed.
 - .5 Adhesive: cold weather acrylic adhesive.

PART 3 EXECUTION

3.1 Pre-Installation Requirement

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry and free from foreign material.

3.2 Installation

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be 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.

3.3 Removable, Pre-fabricated, Insulation and Enclosures

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.4 Installation of Elastomeric Insulation

- .1 Insulation to remain dry at all times. Overlaps to manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 Piping Insulation Schedules

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: SS Bands at 300mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: SS Bands at 300mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.

- .4 TIAC Code: A-6.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-CA; per manufacturer's recommendation.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements: SS Bands at 300mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 Thickness of insulation to be as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000mm long.
 - .2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC Code	Run out	To NPS1	1 ¼-2	2 ½-4	5-6	8 & over
Hot Water Heating	60-94	A-1	25	38	38	38	38	38
Hot Water Heating	< 59	A-1	25	25	25	25	38	38
Domestic HWS/RECIRC		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant (hot gas, liquid, suction)	< 4	A-6	25	25	38	38	38	38
RWL and RWP		C-2	25	25	25	25	25	25
Cooling Coil Condensate Drain		A-3	25	25	25	25	25	25

- .7 Finishes:
 - .1 Exposed indoors: Canvas and/or PVC jacket.
 - .2 Exposed in mechanical rooms: Canvas and/or PVC jacket.
 - .3 Concealed, indoors: ASJ, no further finish.
 - .4 Exposed outdoors: Aluminum jacket.

3.6 Cleaning

- .1 Proceed in accordance with Section 01 01 50 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 91 00 Commissioning
- .2 Section 23 05 93 Testing, Adjusting and Balancing for HVAC

1.2 Quality Assurance

- .1 The commissioning of mechanical systems shall be executed in accordance with the intent of ASHRAE Standard 1 "Guideline for Commissioning of HVAC Systems" and CSA Z320.11 "Building Commissioning".

1.3 General

- .1 Commissioning of the mechanical systems, including the HVAC, and Plumbing and Drainage Systems, shall be carried out by an independent Commissioning Agent acceptable to the Departmental Representative with technicians specifically trained in commissioning procedures.
- .2 The Mechanical Subcontractor shall retain a Commissioning Agent, who shall be active in the commissioning process and actively encourage his own forces and subtrades to work together to achieve optimum system performance for the mechanical systems in a timely manner. Refer to Commissioning Authority Plan for responsibilities of Commissioning Agent.
- .3 It is not intended that this work shall, in any way, replace normal factory start-up service for equipment or relieve the Contractor or his sub-trades of their responsibility for providing first-class installation in satisfactory working order.
- .4 As part of the final commissioning report, submit a Certificate stating that the commissioning procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and finally, that follow-up testing, after the correction of faults and omissions has been completed and recorded.
- .5 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Division 21, 22, 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.
- .6 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

1.4 Commissioning and Demonstration

- .1 Submit a schedule for the commissioning phase of the work. This schedule shall show:
 - .1 Equipment start-up schedule.
 - .2 Submission dates for the various documents required prior to substantial completion.

-
- .3 Timing of the commissioning, testing, balancing, and demonstration process.
 - .2 Commissioning is concluded when the air and water system is balanced and the installation is in full working order and acceptable for use. The work shall include the following:
 - .1 Balancing of the air systems as specified in this section.
 - .2 Set up air diffusers, registers and grilles for optimum distribution/comfort.
 - .3 Plug all air pressure and flow measuring holes.
 - .4 Adjust vibration isolators and earthquake restraints for optimum performance.
 - .5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations. Forms in Section 23 08 02 shall be used for this purpose.
 - .6 Verification of water tightness of all roof and exterior wall penetrations.
 - .7 Verification that coil drain pan operates.
 - .8 Set up all automatic control valves/dampers and automatic temperature control devices.
 - .9 Set up and test all alarm and protective devices.
 - .10 EMCS:
 - .1 Commissioning of EMCS is primarily responsible by Controls Contractor. Refer to Section 25 05 01 EMCS General Requirements.
 - .2 The Commissioning Agent shall assign one person experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls **to verify** the performance of the control systems by conducting random tests of the control sequences until the Commissioning Agent is satisfied that the controls are performing according to the intended control sequences.
 - .3 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material.
 - .3 In addition to the piping, equipment and systems listed above provide commissioning of all plumbing piping, equipment and systems including the following:
 - .1 Domestic cold water including PRV setpoint.
 - .2 Domestic hot water and recirculation including temperature set points.
 - .3 Domestic tempered water including setpoints.

- .4 Sanitary waste and venting.
- .5 Plumbing fixtures including adjustments of all flush valves, and setting temperature limit stops on shower valves.
- .6 Dental vacuum system.
- .7 Dental compressed air system.
- .4 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative. For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to section 25 05 01 EMCS: General Requirements.
- .5 The verification process shall include the demonstration of the following:
 - .1 The ease of access that has been provided throughout for servicing coils, motors, drives, control dampers and damper operators.
 - .2 Location of and opening and closing of all access panels.
 - .3 Operation of all automatic control dampers and automatic temperature control devices.
 - .4 Operation of all alarm and protective devices.
 - .5 Operation of all equipment and systems under each mode of operation, and failure.
- .6 At the completion of commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:
 - .1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.
 - .2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.
 - .3 "As-Built" record drawings, as specified.
 - .4 A list of all alarm and protective devices tested, with the final operating settings.
- .7 Training
 - .1 During "Substantial Performance" review, the Mechanical Contractor, Control Sub-contractor, and other Sub-contractors designated by the Departmental Representative shall provide training to the operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.
 - .2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Departmental Representative, and ready for presentation at this meeting.
 - .3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and traveling expenses for the personnel involved which are attributable to the delay.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 91 00 Commissioning
- .2 Section 22 42 01 Plumbing Specialties and Accessories
- .3 Section 23 05 93 Testing, Adjusting and Balancing for HVAC

1.2 Potable Water Systems

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 22.
 - .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 as a result of flushing and/or cleaning.

1.3 Wet Sprinkler System

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 21.
- .2 Verification of controls, detection devices, alarm devices is specified Division 28.

1.4 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.

PART 2 PRODUCTS

2.1 Not Used

- .1 Not Used.

PART 3 EXECUTION

3.1 Not Used

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|---------------------------|
| .1 | Section 01 01 50 | General Instructions |
| .2 | Section 01 91 00 | Commissioning |
| .3 | Section 23 05 05 | Installation of Pipe Work |

1.2 References

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .2 ASME B18.2.1, Square and Hex Bolts and Screws.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 Canadian Standards Association (CSA)
 - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CGA B149.1, Natural Gas and Propane Installation Code.

1.3 Submittals

- .1 Submit product data in accordance with Section 01 01 50 - General Instructions.
- .2 Indicate on manufacturer's catalogue literature following: valves.

1.4 Closeout Submittals

- .1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.5 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Pipe

- .1 Steel pipe: to ASTM A 53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Underground gas piping: High Density polyethylene pipe meeting the requirements of CSA Standard B-137.4M, "Polyethylene Piping System for Gas Service."
- .3 Epoxy coated steel pipe risers designed for connection to plastic service piping for NPS 2 (50mm) size and smaller.

2.2 Jointing

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Underground Piping shall be joined by heat fusion, electrofusion, or mechanical methods in accordance with CSA Standard Z662 and the manufacturer's instructions.

2.3 Fittings

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A 53/A53M.

2.4 Valves

- .1 Provincial Code and CSA Standard B-137.1 approved, lubricated type.
- .2 All valves used shall match existing and labeled to match existing nomenclature.
- .3 Provide seismic actuated shut off valve at building wall.

PART 3 EXECUTION

3.1 Piping

- .1 Install piping in accordance with applicable Provincial Codes.
- .2 Install in piping accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.2 Valves

- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.
- .3 Provide shutoff valve and insulated union for di-electric isolation of building gas piping.

3.3 Tracer Wires:

- .1 All underground plastic gas piping shall have a tracer wire 14-gauge stranded copper wire, mounted on the top surface of the pipe, secured with plastic straps at two meter intervals.
- .2 Wire to be bonded to steel supply main at connection with plastic run.
- .3 Wire to be run up the transition riser and taped to the steel pipe
- .4 Continuity of tracer wire to be checked.

3.4 Warning Tape:

- .1 All underground natural gas lines shall have a warning tape. Underground warning tape (plain tape only) buried 300mm below grade above pipe.

3.5 Field Quality Control

- .1 Test system in accordance with CAN/CGA B149.1, CAN/CGA B149.2 and requirements of authorities having jurisdiction.

3.6 Purging

- .1 Purge after pressure test in accordance with CAN/CGA B149.1, CAN/CGA B149.2.

3.7 Pre-Start-Up Inspections

- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
- .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.8 Reports

- .1 In accordance with Section 01 91 00 – Commissioning.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results-Mechanical
- .3 Section 23 05 93 Testing Adjusting and Balancing for HVAC

1.2 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.
- .2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.
- .3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .5 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.3 Scope

- .1 All air systems installed by this contract shall be cleaned by a Cleaning Contractor.
- .2 The Cleaning Contractor shall visit the site in the case of existing systems or shall review the drawings and specifications of new systems, in order to be fully acquainted with the scope of work and requirements before tendering. No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site or inspect the contract documents.
- .3 The following air systems shall be cleaned, as applicable:
 - .1 Relief
 - .2 Supply
 - .3 Return
 - .4 Exhaust
 - .5 Air Conditioning
- .4 All components within each system shall be thoroughly cleaned to the Departmental Representative's satisfaction and shall include but not be limited to the following:
 - .1 Intake exhaust and relief louvres
 - .2 Bird screens
 - .3 Auto dampers
 - .4 Filter frames
 - .5 Coils
 - .6 Fans & motors - complete assembly
 - .7 All plenum surfaces
 - .8 Terminal heating/cooling coils

- .9 Supply air grilles, registers and diffusers
- .10 Ductwork
- .11 Mixing boxes, air terminal units
- .12 Return, exhaust and relief air grilles and diffusers.

1.4 Qualifications

- .1 Cleaning shall be performed by a cleaning service company with high capacity cleaning equipment designed specifically for the work involved, executed by personnel specifically trained for the application.

PART 2 PRODUCTS

2.1 Cleaning Equipment

- .1 Cleaning shall generally by high capacity power vacuum.
- .2 High pressure compressed air, wire brushing and/or non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise.

PART 3 EXECUTION

3.1 Cleaning HVAC Systems

- .1 The Cleaning Contractor shall provide access as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work.
- .2 Remove cheesecloth from grilles, etc., let over from the temporary use of the air systems.
- .3 Air systems must not be shut down without prior approval from the Departmental Representative.
- .4 The Cleaning Contractor shall be responsible for removing and replacing filter media. In new buildings this Contractor will remove the temporary filters and replace with new after cleaning the systems. In existing buildings this Contractor may re-use existing filter media (cleaned if possible) or new media will be provided by the Departmental Representative.
- .5 The Cleaning Contractor shall mark balancing damper positions before cleaning and return them to their original position when cleaning is completed unless the system is to be balanced.
- .6 Re-install any grilles, registers and diffusers which may have been removed for cleaning purposes.

3.2 Report

- .1 After completion of the work, the Contractor shall provide four copies of a certificate stating that all systems have been cleaned as specified and that all access panels for all cleaning openings are in place. This certificate shall be placed in the Operating and Maintenance Manuals.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results - Mechanical
- .3 Section 23 07 13 Thermal Insulation for Ducting

1.2 References

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 480/A 480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Agency (NFPA)
 - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - .3 NFPA 91, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible
 - .2 SMACNA HVAC Duct Leakage Test Manual

- .3 IAQ Guideline for Occupied Buildings Under Construction.
- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA).

1.3 Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 01 50 - Shop Drawings, Product Data & Samples.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
 - .1 Sealants.
 - .2 Adhesive
 - .3 Duct tape.
 - .4 Duct liners.

1.4 Quality Assurance

- .1 Certification of Ratings:
 - .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 Section 01 35 33 - Health & Safety Requirements.

1.5 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 and recycling in accordance with Section 01 01 50 – General Instructions.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
 - .4 Separate for reuse and recycling and place in designated containers 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 CEPA, TDGA, Regional and Municipal regulations.
 - .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Pressure Class	Maximum Pressure (Pa)	SMACNA Class	Seal
High Pressure	1,000	[A]	
Medium Pressure	750	[B]	
Low Pressure	500	[B]	

.2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 Ductwork - General

- .1 Duct dimension noted on drawings are clear inside dimensions. Insulation thickness shall be as noted on the drawings.
- .2 All seams, joints and raw edges shall be sealed and covered with glassfab.
- .3 Insulation shall be applied with mechanical fasteners and suitable adhesives. Duct insulation adhesive and coatings shall be non-toxic as defined by WCB Regulations.
- .4 Round duct: with spiral seams. Sections shall be joined with a RT1 slip joint, screw fastened and sealed with no visible duct sealant to interfere with finish painting.
- .5 Exposed round duct shall be installed in a neat workmanlike manner parallel to building walls and roof with no sags or misalignment, and shall be true and round.
- .6 Ductwork downstream of low-pressure single duct air terminal units shall be constructed to 500 Pa low pressure duct.
- .7 Ductwork upstream of single duct air terminal units shall be constructed to 1,000 Pa medium pressure duct.

2.3 Fittings

- .1 Fabrication: to SMACNA. Fittings shall be 2 gauges heavier than connecting ductwork.
- .2 Radius elbows:
 - .1 Rectangular: Centre-line radius equal to 1.5 times width of duct, with single thickness turning vanes.
 - .2 Round: Centre-line radius equal to 1.5 times diameter. 5-gore for 300mm [12"] and larger; die-stamped for 254mm [10"] and smaller.

- .3 Mitered elbows, rectangular:
 - .1 To 400mm [16"]]: with single thickness turning vanes.
 - .2 Over 400mm [16"]]: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: 45° entry on branch.
 - .2 Round main and branch: enter main duct at 45° or with conical connection. The use of spin-in collars is not acceptable.
- .5 Transitions:
 - .1 Diverging: 20° maximum angle.
 - .2 Converging: 30° maximum angle.
- .6 Offsets: full radius elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
- .8 Elbows in autoclave exhaust shall be un-vented, smooth radius construction with centre-line equal to 1.5 times width of duct.

2.4 Galvanized Steel

- .1 Lock forming quality: to ASTM A 653, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.
- .4 Applications:
 - .1 All supply and exhaust ductwork unless otherwise noted.

2.5 Hangers and Supports

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm [20"].
- .2 Hangers, hanger configuration and attachment to structure: to SMACNA.

2.6 Duct Liner

- .1 Fibrous glass duct liner: air stream side faced with FSK facing.
- .2 Rigid:
 - .1 Use on flat surfaces.
 - .2 25mm [1"] or 50mm [2"] thick fibrous glass rigid board duct liner.
 - .3 Density: 36 kg/m³ [2.2 lb/ft³].
 - .4 Thermal resistance: RSI-0.76 [R-4.3] for 25mm [1"], RSI-1.53 [R-8.7] 50mm [2"].
- .3 Flexible:
 - .1 Use on round or oval surfaces.
 - .2 25mm [1"] or 50mm [2"] thick fibrous glass blanket duct liner as indicated.

- .3 Density: 24 kg/m³ [1.5 lb/ft³].
- .4 Thermal resistance: RSI-0.74 [R-4.2] for 25mm [1"], RSI-1.47 [R-8.3] 50mm [2"].
- .4 Fasteners shall be weld pins with metal retaining clips and square head.
- .5 Flame and smoke ratings:
 - .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.7 Sealant

- .1 Oil resistant, polymer-based duct sealant. Temperature range of -23°C to 65°C [-10°F to 150°F]. ULC listed and comply with NFPA 90A and NFPA 90B.
- .2 Flame and smoke ratings:
 - .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.8 Adhesive

- .1 Water-based vinyl copolymer adhesive. Temperature range of -23°C to 71°C [-10°F to 160°F]. ULC listed and comply with NFPA 90A and NFPA 90B. Adhesive shall be non-toxic as defined by W.C.B. Regulations.
- .2 Flame and smoke ratings:
 - .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.9 Duct Tape System

- .1 Two part system combined of treated woven fibreglass tape and liquid sealant/adhesive. ULC listed and comply with NFPA 90A and NFPA 90B.
- .2 Flame and smoke ratings:
 - .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

PART 3 EXECUTION

3.1 General

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA, and as indicated.

- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .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.
- .7 All openings in ductwork shall be sealed with temporary duct cover during construction. Failure to maintain duct cleanliness will require the inside of all air ducts, plenums and equipment in the air stream to be cleaned with an industrial vacuum cleaner before system balancing is started.
- .8 Apply protective galvanize coating to galvanized ductwork and accessories which have been welded.
- .9 Apply duct sealer to all joints of metal ducts, connections to diffusers, plenums and flexible duct.
- .10 Provide medium pressure duct for the following:
 - .1 Ductwork serving systems with air terminal units, extending from the air handling unit discharge to the inlet of air terminal units.
 - .2 As indicated.
- .11 The use of plastic duct tape is not permitted.
- .12 Thermal insulation to Section 23 07 13 – Thermal Insulation for Ducting.

3.2 Hangers

- .1 Strap hangers: Install in accordance with SMACNA.
- .2 Rectangular duct: Extend strap hanger down on both sides of duct, turn under bottom 25mm [1"] minimum. On each strap provide two sheet metal screws on the side and one in the bottom.
- .3 Angle hangers: complete with locking nuts and washers.
- .4 Hanger spacing: to SMACNA.
- .5 Seismic restraint to Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.3 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.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425mm on centres.

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- .3 Acoustically lined ducts shall have perforated inner metal liner.
 - .2 Line inside of ducts where indicated.
 - .3 Duct dimensions, as indicated, are clear inside duct lining.
 - .4 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.
 - .5 Replace damaged areas of liner.
 - .6 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm [1/2"] overlap and fastened to duct.
 - .7 Provide 50mm [2"] liner for ductwork exposed to weather which is not insulated

3.4 Sealing and Taping

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results - Mechanical

1.2 References

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-M86, Fire Tests for Air Ducts.
 - .2 UL 181, Factory Made Air Ducts and Connectors.

1.3 Submittals

- .1 Submittals in accordance with Section 01 01 50 – General Instructions.
- .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.
- .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 Section 01 01 50 – General Instructions.

1.4 Quality Assurance

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Delivery, Storage and Handling

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).
 - .5 Divert unused materials from landfill to recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 General

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Duct

- .1 General:
 - .1 UL-181 listed and labeled as Class I air duct, and complies with NFPA 90A and 90B.
- .2 Non-metallic, Insulated:
 - .1 Constructed of CPE liner duct permanently bonded to a spring steel wire helix and with factory applied fibreglass insulation, lower permeability vapour barrier and laminate jacket for low and medium pressure systems.
 - .2 Maximum rated pressure: 1,000Pa [4" w.g.] positive, 250Pa [1" w.g.] negative.
 - .3 Operating temperature: -29 to 121 °C [-20 to 250 °F].
 - .4 Thermal resistance: RSI-0.74 [R-4.2].
 - .5 Application: cold air supply duct.

- .3 Non-metallic, un-insulated:
 - .1 Constructed of supporting helix of coated spring steel wire permanently bonded to a coated woven fiberglass.
 - .2 Maximum rated pressure: 2,500Pa [10" w.g.] positive, 250Pa [1" w.g.] negative.
 - .3 Operating temperature: -18 to 121 °C [-0 to 250 °F].
 - .4 Application: warm air supply duct.

2.3 Flexible Duct Connectors

- .1 Frame: galvanized sheet metal frame 0.66mm [24 gauge] thick with fabric clenched by means of double locked seams.
- .2 Fabric:
 - .1 Indoor: Fire resistant, self extinguishing, neoprene coated fibreglass fabric, temperature rated at -40°C to 90°C [-40°F to 200°F], thickness of 0.63mm [0.025"].
 - .2 Outdoor: Fire resistant, self extinguishing, DuPont Hypalon coated fibreglass fabric, temperature rated at -40°C to 120°C [-40°F to 250°F], thickness of 0.61mm [0.024"].

2.4 Access Doors in Ducts

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame and 25mm [1"] thick rigid fibreglass insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

2.5 Turning Vanes

- .1 Factory-made, single or double thickness as specified elsewhere, with trailing edge. Vanes shall be constructed of same material as duct, 0.55mm [26 gauge].
- .2 Rails shall be fabricated of same material as duct, 0.66m [24 gauge]. Vanes shall be attached to rails using fasteners.

2.6 Instrument Test Ports

- .1 Alloy casting with screw-in cap, neoprene gasket, 18 mm [3/4"] inside diameter opening for pitot tube or velometer.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

- .1 Flexible Duct
 - .1 Provide flexible duct connecting air outlets as indicated. Flexible duct with integral volume damper is not acceptable.
 - .2 Install flexible duct fully extended, without tight bends and kinks. The radius at the centre-line shall not be less than one duct diameter. Do not install in compressed state.
 - .3 Length of flexible duct shall within 1,500mm to 2,100mm (5'-0" to 7'-0").
 - .4 Provide support for flexible duct at 1,200mm (4'-0") on centre. Maximum permissible sag is 42 mm/m (1/2 inch per foot) of spacing between support. A connection to a rigid duct or equipment shall be considered a support joint.
 - .5 Sheet metal strap for flexible duct support shall be minimum 38mm (1-1/2") wide.
 - .6 Sheet metal collars to which the flexible ducts are attached shall be minimum 50mm (2") in length.
 - .7 Repair torn or damaged vapour barrier jackets approved duct tape. If the internal core is penetrated, replace the flexible duct.
 - .8 Do not use flexible duct for connecting mixing box and air terminal unit inlets.
- .2 Flexible Duct Connectors
 - .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.

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- .2 Length of connection: 100mm [4"].
 - .3 Minimum distance between metal parts when system in operation: 75mm [3"].
 - .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.
 - .3 Access Doors in Ducts
 - .1 Size:
 - .1 610mm x 1520 mm [24"x60"] for person size entry.
 - .2 460mm x 460 mm [18"x18"] for service.
 - .3 300mm x 200mm [12"x8"] for cleaning.
 - .4 As indicated.
 - .2 Locations:
 - .1 Fire dampers and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 On both sides of turning vanes.
 - .7 At the base of all duct risers.
 - .8 At 12,000m [40'-0"] intervals in all duct systems, and 6,000mm [20'-0"] intervals in horizontal exhaust ducts for cleaning purposes.
 - .4 Instrument Test Ports
 - .1 Install in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 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.

- .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .5 Turning Vanes
- .1 Install in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 - .2 SMACNA – Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2, Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505, Fusible Links for Fire Protection Service.
- .3 National Fire Protection Agency (NFPA)
 - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

1.3 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Indicate the following:
 - .1 Volume dampers.
 - .2 Remote control damper regulators.
 - .3 Fire dampers.
 - .4 Fire stop flaps.
 - .5 Smoke dampers.
 - .6 Backdraft dampers.
 - .7 Relief dampers.
- .2 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

- .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.

1.4 Quality Assurance

- .1 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

1.6 Extra Materials

- .1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.
- .2 Provide following:
 - .1 Six (6) fusible links for each type of fire damper.

PART 2 PRODUCTS

2.1 General

- .1 Manufacture to SMACNA standards.

2.2 Single Blade Volume Dampers

- .1 Blade: Of same material as duct. Two gauges heavier than duct but not less than 0.6mm [24 gauge], stiffened.
- .2 Maximum dimension: 305mm [12"] height for rectangular ducts.
- .3 Axles: 9.5mm [3/8"] continuous square rod up to 457mm [18"] wide duct, and 13mm [1/2"] continuous square rod up to 1,219mm [48"] wide duct.
- .4 Linkage: shaft extension with locking quadrant and position indicator.
- .5 Bearings: bronze oilite.
- .6 Frame: of the same material as duct. Complete with angle stop for rectangular duct.

2.3 Multi-Bladed Volume Dampers

- .1 Opposed blades: 1.2mm [18 gauge] of same material as adjacent duct, stiffened.
- .2 Maximum blade width: 150mm [6"].
- .3 Axles: 9.5mm [3/8"] or 13mm [1/2"] continuous square rod.
- .4 Bearings: bronze oilite.
- .5 Linkage: shaft extension with locking quadrant and position indicator.
- .6 Frame: 51mm [2"] or 40 x 13 x 3 mm [1-1/2"x1/2"x1/8"] structural or roll-formed channel, complete with angle stop.

2.4 Remote Control Damper Regulators

- .1 Cable controlled damper regulator for concealed ceiling applications.
- .2 Cable: 1.4mm [0.054] stainless steel Bowden cable encapsulated in 1.6mm [1/16"] flexible galvanized spiral wire sheath.
- .3 Control kit: die-cast aluminum housing with 76mm [3"] diameter chrome-plated cover, with steel rack and pinion gear drive converting rotary motion to push-pull motion.
- .4 Provide hardware kit for damper by others.

2.5 Fire Dampers

- .1 Arrangement B, ULC listed and labelled, meeting requirements of provincial fire authority and NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112. Factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .2 Frame and integral sleeve shall be of same material as duct with mounting angles furnished by the damper manufacturer. Sleeve thickness to SMACNA and NFPA-90A.
- .3 Top hinged: offset, round or square, interlocking blade type and sized to maintain full duct cross section.
- .4 Fusible link: 74°C [165°F], replaceable. Gravity-operated for vertical installation and spring-actuated for horizontal installation.
- .5 40 x 40 x 3 mm [1-1/2" x 1-1/2" x 1/8"] retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

2.6 Fire Stop Flaps

- .1 To be ULC listed and labelled and fire tested in accordance with CAN4-S112.2.
- .2 Construct of same material as duct, minimum 1.5 mm thick with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps to be held open with fusible link conforming to ULC-S505 and close at [74] °C [or as indicated].

2.7 Smoke Dampers

- .1 Class I leakage rate, with airfoil blades, pressure sensitive blade edge and jamb seals for low leakage, concealed linkage. Both damper and actuator shall be ULC listed and labelled.
- .2 Constructed frame and blades of same material as duct.
- .3 Operation: Normally open position. Damper shall close upon detection of smoke or from remote alarm signalling device.

2.8 Backdraft Dampers

- .1 Multi-blade, gravity-operated, centre pivoted, constructed of same material as duct with nylon bearings.

2.9 Relief Dampers

- .1 Multi-blade, insulated, counter-weight, centre pivoted, constructed of same material as duct with brass bearings, set to open at 12.4 Pa [0.05 in. w.g.] static pressure unless otherwise noted.

PART 3 EXECUTION

3.1 General

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.

3.2 Volume Damper

- .1 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .2 Run-outs to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .3 All dampers to be vibration free.
- .4 Attach fluorescent tape to regulator handle for concealed volume dampers.
- .5 Provide remote control damper regulator for volume dampers above inaccessible ceiling where ceiling access panel is not provided, and as indicated.

3.3 Fire Dampers

- .1 Install in accordance to Part 3, Sub-section 3.1.8 of the National Building Code.
- .2 Provide fire damper where duct penetrates through fire-rated floor, wall, or fire separation.
- .3 Provide fire stop flap at fire-rated ceiling assembly.
- .4 Provide access door per Section 23 33 00 – Air Duct Accessories.

3.4 Smoke Dampers

- .1 Provide smoke dampers in the supply and return air streams if the air handling system:
 - .1 serves more than one storey.
 - .2 serves more than one suite in a storey.
- .2 Coordinate with Division 26 for power and Division 28 for interlock/interfaces.
- .3 Provide access door per Section 23 33 00 – Air Duct Accessories.

3.5 Field Quality Control

- .1 Tests:
 - .1 Tests to cover period of not less than 2 days and demonstrate that system is functioning as specified.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 01 91 00 Commissioning
- .3 Section 23 05 13 Common Motor Requirements for HVAC Equipment
- .4 Section 23 05 48 Vibration & Seismic Controls for HVAC Piping & Equipment
- .5 Section 23 08 00 Commissioning of Mechanical Systems
- .6 Section 23 33 00 Air Duct Accessories

1.2 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.

1.3 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, static pressure, BHP, HP, 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.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 01 50 - General Instructions.
- .3 Provide:
 - .1 Fan performance curves showing point of operation, BHP and efficiency.
 - .2 Sound rating data at point of operation.
- .4 Indicate:
 - .1 Motors and sheaves details.
- .5 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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 Section 01 01 50 – General Instructions.

1.5 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.6 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .3 Waste Management and Disposal:
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Fans General

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers where specified.
 - .3 Sizes as specified.
- .2 Accessories and hardware: as specified.
- .3 Scroll casing drains: as indicated.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for Ductwork Piping and Equipment.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 Centrifugal Fans

- .1 Fan wheels:
 - .1 welded steel construction.
 - .2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.
 - .3 Air foil or backward inclined 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 (L50) of 200,000 hours.
- .3 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, 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 or latched airtight access doors with handles.
- .4 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.3 Cabinet Fans – General Purpose

- .1 Fan characteristics and construction: as centrifugal fans.
- .2 Cabinet hung single wheel with centrifugal fan in factory fabricated casing complete with vibration isolators and seismic control measures, motor and other accessories as noted.
- .3 Fabricate casing of zinc coated or phosphate treated steel of 18 gauge 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.

2.4 In-Line Centrifugal Fans

- .1 Characteristics and construction: as for centrifugal fan wheels.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

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 Fan Installation

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, 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 in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.4 Field Quality Control

- .1 Commissioning:
 - .1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 01 91 00 Commissioning
- .3 Section 23 05 00 Common Work Results – Mechanical
- .4 Section 23 08 00 Commissioning of Mechanical Systems

1.2 References

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 51/AMCA 210, Laboratory Methods of Testing Fans for Rating.
 - .2 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .2 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.
- .3 Underwriter's Laboratories (UL)

1.3 System Description

- .1 Performance Requirements:
 - .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.4 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

- .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 250 Pa in accordance with ISO 3741 for 2nd through 7th octave band.
 - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
 - .3 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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 Section 01 01 50 – General Instructions.

1.5 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.6 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .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 and recycling in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Manufactured Units

- .1 Terminal units of the same type to be product of one manufacturer.

2.2 Single Duct VAV Air Terminal Units

- .1 Pressure independent reset to air flow between minimum 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 30 NC at 250 Pa.
- .5 Air velocity sensor: pitot rack as standard to manufacturer.
- .6 Complete with:
 - .1 Sound attenuator: as indicated.
 - .2 Reheat coil: as indicated.
- .7 Casing: constructed of 22 gauge galvanized steel, internally lined with 12 mm fibrous glass, to ANSI/NFPA 90A. Mount control components inside protective metal shroud.
- .8 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.
- .9 Controller and transformer for controls by Controls Contractor.

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 in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with minimum of three duct diameters of straight inlet duct, same size as inlet. Flexible duct is not permitted upstream of air terminal units and mixing boxes.
- .4 Locate so that controls, dampers and access panels are easily accessible.

3.3 Field Quality Control

- .1 Commissioning:
 - .1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

3.4 Cleaning

- .1 Proceed in accordance with Section 01 01 50 – General Instructions, and Section 23 31 10 - Cleaning of Mechanical Duct Systems.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical

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 Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
- .2 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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.

1.4 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.
 - .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 and recycling in accordance with Section 01 01 50 – General Instructions.

1.6 Maintenance

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

PART 2 PRODUCTS

2.1 General

- .1 Size as indicated.
- .2 Capacity, pressure drop, terminal velocity, throw, noise level, neck velocity shall conform to intended performances of specified materials.
- .3 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified on architectural reflected ceiling plans.
 - .3 Concealed fasteners.
- .4 Where balancing damper is scheduled, damper shall be of opposed blade type.
- .5 Diffusers, grilles and registers in areas with high humidity shall be of aluminum construction.
- .6 Provide neck transition as required.

2.2 Manufactured Units

- .1 Grilles, registers and diffusers of same generic type, product of one manufacturer.

2.3 Return, Exhaust, Transfer and Supply Grilles and Registers

- .1 Return grille, Type RG-1: egg crate, steel, 13 mm x 13 mm x 13 mm aluminum grid core, lay-in or surface mount matching ceiling type. Finish: white baked enamel.
- .2 Return grille, Type RG-2: fixed louvre, steel, 32 mm border, 45 degree deflection, 19mm blade spacing, front blades parallel to long dimension, surface mount. Finish: white baked enamel.
- .3 Exhaust grille, Type EG-1 "matching RG-1 verbiage."
- .4 Exhaust grille, Type EG-2: heavy duty 14 gauge steel, fixed louvre blades 19 mm on center with 45 degree deflection and parallel to the long dimension, 32 mm border, surface mount. Finish: white baked enamel.
- .5 Supply grille, Type SG-1: adjustable louvre, steel, 32 mm border, double deflection blades 19mm on center with front blades parallel to long dimension, surface mount. Finish: powder coated finish matching one (1) of the manufacturer's standard colors, as selected by the Departmental Representative to compliment the exposed duct finish.

2.4 Diffusers

- .1 Supply diffuser, Type SD-1: square plaque diffuser, four-way throw, steel, having fixed pattern, round inlet collar, lay-in or surface mount matching ceiling type. Finish: white baked enamel.

2.5 Undercut and Door Grilles

- .1 Type A: 20 mm undercut.
- .2 Type B: door grille, 508 mm x 305 mm, aluminum, 32 mm border, both sides, countersunk screw hole fastening, sight proof. Finish: custom baked enamel finish; colour to be selected by Departmental Representative at shop drawing review.
- .3 Type C: door grille, 508 mm x 406 mm, aluminum, 32 mm border, both sides, countersunk screw hole fastening, sight proof. Finish: custom baked enamel finish; colour to be selected by Departmental Representative at shop drawing review.
- .4 Type D: door grille with fire damper, 457 mm x 356 mm. Finish: custom baked enamel finish; colour to be selected by Departmental Representative at shop drawing review.

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 in accordance with manufacturer's 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.

- .5 Paint matte black behind all diffusers, grilles and registers so that no metallic part will be visible from the exposed side.

END OF SECTION

PART 1 GENERAL

1.1 Halocarbons

- .1 Comply with all of:
 - .1 Federal Halocarbon Regulations;
 - .2 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment Canada "Refrigeration Code of Practice") Cat. No.: En14-207/2015E-PDF. . April, 2015.
- .2 Work on Halocarbon Systems includes installation, servicing, leak testing or charging of a refrigeration system or an air-conditioning system or doing any other work on the system that may result in the release of a halocarbon.
- .3 All work on Halocarbon Systems shall be carried out only by a "Certified Person" as defined by the Federal Halocarbon Regulations.
 - .1 Provide copies of all technicians' certificates to the Departmental Representative.
- .4 Halocarbons listed under Item 1 through 10 of Schedule 1 of Federal Halocarbon Regulations, 2003 (SOR/2003-289) are not acceptable refrigerants.
- .5 Document **all** work on Halocarbon Systems using CSCs halocarbon form "**Information Required for Refrigeration Systems at Federal Correctional Facilities**". Obtain the latest form from Departmental Representative. Affix the completed form to equipment, and submit a copy of the form to Departmental Representative.
- .6 Comply with the following timelines:
 - .1 Upon delivery of halocarbon-containing equipment to site, submit the following information to Departmental Representative within 24 hours of service;
 - .1 Make
 - .2 Model
 - .3 Serial number
 - .4 Type of halocarbon
 - .5 Halocarbon charging capacity of system (kg or lbs)
 - .6 Factory Halocarbon Charge (kg or lbs)
 - .7 Cooling capacity (kW, Btuh, or Tons)
 - .2 Leak-test factory-charged halocarbon-containing equipment containing over 10kg of refrigerant in accordance with the Refrigeration Code of Practice within one week of equipment delivery to site.
 - .3 Leak-test field-charged halocarbon-containing equipment in accordance with Section 4.4 of the Refrigeration Code of Practice at the time of field charging of system.

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- .4 For all work on Halocarbon Systems, submit forms to Departmental Representative within 48 hours of work.
 - .5 For release of halocarbons >10 kg and <100 kg, submit forms to Departmental Representative within 24 hours of discovery of release.
 - .6 For release or potential release of halocarbons > 100 kg, submit forms to Departmental Representative **immediately**.
 - .7 Conduct annual leak tests of halocarbon-containing equipment with 19kW (5.4 tons) or greater cooling capacity in accordance with the Federal Halocarbon Regulations, 2003 until such time as Interim Certificate of Completion is issued.

END of SECTION

Part 1 GENERAL

1.1 Description

Work Includes: Custom air handling equipment. Coordinate installation with all trades involved. See Divisions 1 for General Requirements.

1.2 Submittals

Submit shop drawings and product data according to Division 1. The following is to be provided and failure to provide complete information will result in the submittal being returned without review. The supplier is responsible for highlighting any variances in the equipment submitted to that specified.

1. Unit dimensions, weights including center of gravity of all sections, and location of components. Equipment drawings shall show plan and elevation and be to scale. Indicate all required clearances for service of the equipment.
2. Provide equipment material gauges, finishes, and construction details. Include all relevant technical information of components to be provided, including but not limited to, the information noted in the Mechanical Schedules of specification 23 90 00.
3. Fan performance curves with the operating condition clearly noted. All fan curves are to be corrected for elevation. Include fan sound power levels. Provide a static pressure summary clearly indicating internal and external pressures for the equipment.
4. Provide equipment sound power levels at the inlet, discharge, and radiated.
5. Provide manufacturer's coil selections to ARI 410 corrected for elevation. Clearly indicate materials of construction, fluid properties, and pressure drops.
6. Provide filter information including: initial APD, recommended final APD, dust spot efficiency, MERV rating, media, and frame description.
7. Provide motor ratings, enclosure type, electrical characteristics, and efficiencies.
8. Provide requirements for power supply wiring including diagrams clearly indicating factory-installed and field-installed wiring.

1.3 Quality Assurance

1. The air handler fans shall conform to AMCA standards for sound and air performance. Airfoil fans shall bear AMCA certified rating seals. Fan sound ratings shall be AMCA rated and third party certified. Sound ratings, without third party verification are unacceptable.
2. The air handler coils shall have ARI 410 certification.
3. The air handler equipment casing shall be tested by an independent third party to ASTM E90-90 for transmission loss and ASTM C423-90A for sound absorption.

4. All equipment shall be listed in accordance to the applicable UL requirements for custom air handlers and be labeled CSA, UL or ETL. Individual component listing is not acceptable.
5. The equipment shall meet the scheduled performance for airflow rates, static pressure and sound value. Coil and filter face velocities scheduled are maximum and are not to be exceeded. The coil flow rates and pressure drops shall be within 10% of the specified values.
6. All wiring shall be in accordance with the National Electric Code (NEC).
7. The heat pump unit shall be factory charged with R410A.
8. The heat pump unit shall be tested by a National Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

1.4 Operation and Maintenance Data

The manufacturer shall submit both hard copy and an electronic copy of the operation and maintenance data for the equipment. The information shall include lubrication instructions, filter replacement, belt adjustment, motor maintenance, split attachment, spare parts list, and a wiring diagram.

1.5 Delivery Storage and Handling

1. The contractor shall store and protect the equipment under provisions of Division 1. The contractor shall store the products in a clean, dry place, protect them from the elements, and shall handle them carefully to avoid damage to enclosures, components, and finish.
2. The manufacturer shall deliver the products to site on a factory base rail and encapsulated in a minimum 6 mil poly shrink wrap. If a unit is shipped in split sections, each section shall be individually wrapped. Sections shall be wrapped regardless of whether the unit is for indoor or outdoor use.
3. If the units are used for temporary heat, prior to turning over to the owner, all dust and debris shall be cleaned from the unit and filters replaced. Use of the units for temporary purposes during construction must be approved by the unit manufacturer and Departmental Representative in advance.
4. The contractor shall follow rigging instructions provided by the manufacturer and shall use all lifting points provided on the channel base of the unit.

1.6 Warranty

1. Standard limited warranty – the manufacturer shall warrant the original owner that under normal use and maintenance for comfort cooling and conditioning applications such products (the “Products”) will be free from defects in material and workmanship. This

warranty applies to compressor and all parts and is limited in duration to ten (10) years starting from the "installation date" which is one of the two dates below:

- The installation date is the date that the unit is originally commissioned, but no later than 18 months after the manufacture date noted on the unit's rating plate.
- If the date the unit is originally commissioned cannot be verified, the installation date is three months after the manufacture date.

Part 2 PRODUCTS

2.1 Air Handler – General

The manufacturer shall provide the factory assembled air handling unit in the configuration and dimensions as indicated on the drawings. The unit shall include all specified components installed at the factory. Field fabrication of the units or their components is not acceptable.

2.2 Air Handler – Casing

1. The 50mm (2") thick wall and roof, 16 gauge steel exterior casing walls and roof shall be acoustic panels with panel sizes not to exceed 610mm (24"). Provide a double wall unit with wall seams that are turned inward to provide a clean, flush unit exterior. All wall panels shall be secured on 203mm (8") centers without the use of mechanical fasteners. All panel seams shall be caulked with clear silicone applied after the unit has been painted.
2. The 22 gauge G90 solid exterior washdown liner and 22 gauge G90 washdown interior liner shall be of thermal break construction with gasket between inner and outer wall skin. All mechanical fasteners shall have rubber washers.
3. The 50mm (2") thick insulation minimum density shall be 48 kg/m³ (3 lbs/ft³) and a minimum conductivity factor shall be 0.033 W/m.K (0.23 Btu.in/ft².hr. °F) Insulation minimum sound absorption coefficient shall be 1.05. All insulation and accessories including sealants must have a composite fire and smoke hazard rating of 25/50 per ASTM E-84 and UL 723.
4. The unit shall meet a deflection criteria of 1/300 of the panel span at 2.5 kPa (10"w.g.) and the air handling unit manufacturer shall provide a casing deflection test (upon request) to indicate compliance. If the casing cannot meet the deflection criteria; the manufacturer shall provide additional internal reinforcement.
5. The unit casing shall meet a leakage rate of 0.75% or less of the total airflow, on both positive and negative pressure sections at 2.5 kPa (10 "w.g.).
6. Casing panels shall be tested in accordance to ASTM Standard C-423 for sound absorption and ASTM E90-90 for transmission loss. The air handler shall have an NRC of .95 or greater and STC of 35 or greater.

2.3 Air Handler – Base

1. Unit shall be constructed on a structural C-channel perimeter base with intermediate channel and angle support. Units that exceed 7.3m (24 ft.) shall have a 203mm (8") minimum base rail. Regardless of the frame size, the channel shall meet a deflection criteria of 1/240" for an unsupported span.
2. Provide 12 gauge steel flat floor fully welded to the intermediate support members and all seams shall be continuously welded. Floors that are attached with screws or adhesive sealants are not acceptable.
3. The base shall be insulated with 50mm (2") thick spray polyurethane foam or fiberglass sheeted with an unpainted, galvanized liner.
4. The base pan shall have an integral 40mm (1.5") water dam including all floor penetrations. Base shall be provided with a minimum four (4) structural weld-on lifting lugs per section. Manufacturers who cannot provide a water dam constructible are not acceptable.
5. All drain connections shall be extended through the unit base rail and capped. Minimum drain size shall be 30mm (1.25"). Drains shall be steel or copper pipe.

2.4 Air Handler – Access Doors

1. Access doors shall be double walled with 16 gauge galvanized steel exterior and 22 gauge solid interior panel. Doors must be of the same thickness as the wall. Provide a reinforced door frame so that the opening remains square during manufacturing and installation. Door frames which are formed from the casing wall are not acceptable. Door insulation shall be 48 kg/m³ (3 lbs/ft³).
2. Doors shall be sealed continuously with a double gasket arrangement with a neoprene "knife edge" seal and a 20mm (3/4") automotive bulb seal. Seals requiring pop rivet or screwed attachment are not acceptable. Doors with a single gasket sealing system are not acceptable. Minimum door opening to be 610mm x 1829mm (24" x 72"), height permitting.
3. Doors shall have a minimum of two (2) glass-reinforced glass reinforced nylon handle. The handles shall be operable from either side of the door. Provide fan section doors with a locking device that is part of the handle. Fan section minimum door width must allow for removal of the fan motor.
4. Access doors shall open against system pressure, wherever feasible. In the event unit size does not allow for in-swing doors on positive pressure compartments, provide a safety pressure relief latch.

2.5 Air Handler – Finish

1. The units shall be air dried finish with SW 2114 Gris Grey color.
2. The finish shall be zero induction epoxy prime coat with a non-isocyanate acrylic finish. The system shall be chemical curing to assure a hard, chemical resistant surface with strong color stability, UV resistance and gloss protection. Results for final paint thickness test results shall be submitted upon request.

2.6 Air Handler – Fan

1. The minimum fan sizes acceptable are as scheduled. Refer to schedule for fan types.
2. Fan shall be selected at an operating point no less than a 100 RPM below the fan wheel class limit.
3. Fans shall be tested in accordance with AMCA publication 211 and Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.
4. Fans shall be centrifugal plenum fan incorporating a 7 blade wheel; aluminum inlet plate with removable spun inlet cone. Fan wheels up to and including 1120mm (44") diameter shall be of aluminum construction only. The fan shall be provided in an AMCA Arrangement 1 configuration (direct drive).
5. The blades shall be continuously welded, die-formed Airfoil type, designed for maximum efficiency and quiet operation. Partial welding is not acceptable on airfoil blades.
6. Fan impellers shall be statically and dynamically balanced and the complete fan assembly test balanced at operating speed prior to shipment. The manufacturer shall provide balance report to owner (upon request).
7. Fan performance data shall correspond to Precision Class 3 as defined by DIN 24 166.
8. Bearings shall be heavy-duty grease lubricated, self aligning ball or pillow block rated for a minimum life (L-10) in excess of 150,000 hours at the maximum operating speed. Provide extended lubrication lines for the bearings to motor side of the fan.

2.7 Air Handler – Vibration Isolation

1. Fan and motor shall be mounted on a welded structural steel epoxy coated isolation base. Formed metal isolation bases are not acceptable.
2. Provide a minimum of four seismically restrained OSHPOD approved isolators. Minimum isolation efficiency acceptable is 98%. Manufacturer is to provide isolation selection as part of the submittal.
3. The minimum static spring deflection shall be 25mm (1").
4. No penetrations shall be made in the floor to anchor isolators. Anchor bolts or any penetrations in the floor, regardless of sealing method, are prohibited.
5. Spring thrust restraints are required for all fans which will travel more than 6mm (1/4") when operating. Springs shall be sized and adjusted so that the assembly floats at design operating condition.

2.8 Air Handler – Motors and Drives

1. Internally mounted motor shall be provided with adjustable slide base to allow adjustment of belt tension.
2. Motors shall be high efficiency NEMA design B, insulated for 40°C (104°F) ambient continuous duty conditions. Motor service factor to be 1.15. Motors to be tested and rated to IEEE standard 112 test method B and NEMA MG1 12.53. All motors to be mounted on an adjustable motor mount base. Motors with a 256T frame size or larger, shall have a dual bolt slide adjustable base.
3. Fan motors shall be heavy duty premium efficiency, inverter ready, operable at the rated voltage scheduled, with an ODP motor enclosure.

Fan motors shall be suitable for operation with VFD and meet NEMA STD MG1 Part 31.4.4.2. Motor shall have Class F insulation, low-loss electrical grade lamination steel, ISR magnet wire and a three year warranty. Fan motors shall be inverter ready.

4. V-belt drive shall have a 1.5 service factor based on the motor nameplate rating. Adjustable sheaves shall be provided on motors 3.7 kW (5 HP) and less. Drives shall be selected with no less than 2 belt minimum for motors greater than 3.7 kW (5 HP).

2.9 Air Handler – Coils

1. Coils shall be rated in accordance with ARI Standard 410. Minimum capacity and sizes are as scheduled.
2. Coils shall be tested to 2172 kPa (315 psi) and be suitable for operation at 1724 kPa (250 psi).
3. Tube material shall be 16mm (5/8") OD tube diameter with 0.5mm (0.020") copper tube wall.
4. Fin material shall be 0.20mm (0.0075") aluminum with a maximum 10 fins per 25mm (inch).
5. Galvanized casing material.
6. Copper coil connection.
7. Coils shall be fully enclosed within the casing and cooling coil drain pans shall extend fully under the coil header and return bends. Coils shall be mounted on angle racks such that the coils may be individually removed. Cooling coil racks shall be 304 stainless steel and heating coil racks shall be galvanized steel.
8. Coil connections shall be extended through the unit casing. Provide grommet seals where the coils penetrate the casing and completely seal off the internal side of the coil penetration.
9. Coils shall be fully drainable. Provide a drain and vent connection on each coil and extend to the outside of the unit casing.

10. Provide a continuously welded 16 gauge 304 stainless steel drain pan double sloped for positive drainage under all cooling coils. Intermediate drain pans for stacked coil configurations are to be the same material as the primary drain pan interconnected with 25mm (1") copper drain line.

2.10 Air Handler – Filters

1. Pre-filters shall be 50mm (2") pleated disposable MERV 8 filters with minimum efficiency and area as scheduled. Each filter shall consist of non-woven synthetic media, support grid and frame. Filters shall be listed UL Class II.
2. Pre-filters shall be installed on prefabricated galvanized rack. Filters shall lift out for upstream access where available, or slide out where access is not available.
3. Final filters shall be as scheduled. The filters shall be high performance, 305mm (12") deep pleated MERV 14, totally rigid and disposable. Filter media shall be high density microfine glass fibers laminated to a non-woven synthetic backing with media support grid, contour stabilizers and a galvanized enclosing frame. Filters shall be listed UL Class II.
4. The filters shall be installed in a factory fabricated frame of 16 gauge galvanized steel. The frames shall be fitted with gaskets and heavy duty, positive sealing, mechanical fasteners.
5. Provide filter gauge with a signal gauge to indicate change out for each bank of filters. The gauges shall be equal to Dwyer 2000, magnehelic. Filter gauge shall be flush mounted within the casing; surface mounted gauges are not acceptable.

2.11 Air Handler – Dampers

1. Damper frames and blades shall be a minimum 12 gauge extruded aluminum. Blades shall be single unit airfoil design 150mm (6") wide.
2. Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. The standard frame shall be 50mm x 100mm x 16mm (2" x 4" x 5/8") on the linkage side, 25mm x 100mm x 25mm (1" x 4" x 1") on all other sides.
3. Pivot rods shall be 22mm (7/8") hexagon extruded aluminum interlocking into the blade section. Bearings shall be designed to eliminate metal to metal contact. Bearings shall be one of a double seal type with a Celcon inner bearing fixed to hexagon headed aluminum pivot rod rotating within Polycarbonate outer bearing inserted into the damper frame to prevent the outer bearing from rotating.
4. Blade hardware and linkage shall be installed within the frame so as to not be exposed to the air stream. All hardware shall be non-corrosive, reinforced cadmium plated steel.
5. Dampers are designed for minimum air leakage by means of overlapping seals.
6. Jackshaft assemblies are to be provided for multiple damper assemblies.

2.12 Air Handler – Electrical

1. The air handler shall be factory wired and tested.
2. Provide separate power connections required: Fans (600V / 3Ph / 60Hz) and Lighting (120V / 1Ph / 60Hz)
3. Wiring shall comply with the latest NEC code requirements. The units shall be CSA/NRTL or ETL listed as a complete unit. Individual listing of components is not acceptable.
4. Motors shall be controlled by variable frequency drive with microprocessor and PWM adjustable frequency. VFD shall be complete with 3% impedance input reactor, PID setpoint controller, under-voltage relay and three contactor bypass or electronic bypass. Outdoor units shall include an integral ventilated control panel recessed within the air handler casing. Access door construction shall be identical to air handler access doors. Control cabinet shall be vented to positive, treated (cooled) air and to negative return air using 25mm (1") diameter conduit.
5. Provide a light within each service section. Lights shall be in vapor proof enclosure with guard and a 25W compact fluorescent bulb. Wire lights to single switch mounted at 1220mm (48") above the installed level of the equipment. Provide adjacent to the supply fan a GFI duplex service receptacle. Light and service receptacle to remain powered when the unit disconnect is open.

2.13 Air Handler – High Efficiency Gas Burner

1. This heat module series provides application flexibility and the latest tubular heat exchanger technology.
2. Recognized under ANSI Z83.8 by ETL.
3. Higher efficiency, lower internal static pressure.
4. Extended operational life due to tubes expanded into collector box so welding is eliminated.
5. Accommodates a wide range of gas inputs from 44 kW (150 MBH) to 117 kW (400 MBH), natural or propane gases. See Mechanical Schedule for gas input.
6. Advanced heat exchanger. Made of 29-4C stainless steel. Secondary condensing coil for maximum strength and corrosion resistance. Primary is made of 409 stainless steel tubes which are expanded to the collector box. No welding is used in the manufacturing process. This makes the high efficiency heat exchanger highly resistant to thermal fatigue and other stresses caused by repeated heating and cooling.
7. Condensing, 93%+ combustion efficiency for an outdoor rooftop unit with a modulating 5:1 turn down ratio.

8. Pre-wired control package includes long – life draft inducer, ignition control, gas valve, spark igniter, flame sensor, air switch and flame rollout switches - opening provided for disc-type high limit. 115V / 60 Hz

2.14 Heat Pump System Design Description

1. Provide a variable capacity heat pump air conditioning system (heat or cool) system as specified.
2. The system shall consist of one or more evaporators using PID control, the manufacturer's recommended joints and headers, a two-pipe refrigeration distribution system and variable refrigerant volume (VRV) condenser unit.
3. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.
4. The condensing unit may connect an evaporator nominal capacity up to 200% of the condensing unit nominal capacity. All zones are each capable of operating separately with individual temperature control.
5. The condensing unit shall be interconnected to evaporator unit models. The indoor units shall be connected to the condensing unit utilizing the manufacturer's specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.
6. Operation of the system shall permit either cooling or heating of all of the evaporator units simultaneously. Each evaporator unit or group thereof shall be able to provide set temperature independently via a BMS interface.

2.15 Heat Pump System VRV Features and Benefits

1. Voltage Platform - Heat pump condensing units shall be available with a 575V / 3ph / 60Hz power supply.
2. Low Ambient Heating – Unit shall provide air cooled heating operation down to -13°Fwb (-25°Cwb).
3. Stable Operation – System shall provide stable inverter operation at varied ambient conditions.
4. No Drain Pan Heater – system shall be capable of heating operation at temperatures below 0°Fwb (-18°Cwb) without the need for a drain pan heater.
5. Auto Changeover – System shall, below the field selected outdoor ambient temperature provide signal to initiate auxiliary or back up heat.

6. Independent Control - Each evaporator unit shall use a dedicated electronic expansion valve with up to 2000 positions for independent control.
7. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all “inverter” based flash vapor injection compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions. Evaporator unit shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.
8. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.
9. Independent Control - Each evaporator unit shall use a dedicated electronic expansion valve for independent control.
10. Flexible Design –
 - a. Systems shall be capable of up to 540ft (165m) [623 ft. (190m) equivalent] of linear piping between the condensing unit and furthest located evaporator unit.
 - b. Systems shall be capable of up to 3,280ft (1,000m) total “one-way” piping in the piping network.
 - c. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units.
 - d. Systems shall be capable of up to 295ft (90m) from the first branch point.
 - e. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.
 - f. Systems shall be capable of 98ft (30m) vertical separation between evaporator units.
 - g. Condensing units shall be supported with a fan motor ESP up to 0.32” WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
11. Oil return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.
12. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.
13. Outside Air – Systems shall provide outside air capability.

14. Space saving – Each system shall have a condensing unit module footprint no larger than 66-11/16” x 48-7/8” x 30-3/16” (1694mm x 1242mm x 767mm).
15. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.
16. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.
17. Each system shall be capable of integrating with open protocol BACnet building management systems.
18. The ambient operating range in cooling will be 23°Fdb (-5°Cdb) ~ 122°Fdb (50°Cdb). Cooling mode indoor room temperature range will be 57-77°Fwb (13.8 - 25°Cwb). The ambient operating range in heating will be -13° – 60°Fwb (-25 – 15.5°Cwb). Heating mode indoor room temperature range will be 59°Fdb - 80°Fdb (15°Cdb – 26.7°Cdb).

2.16 Heat Pump System Wiring and Refrigerant Piping

1. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
2. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple evaporator units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.
3. The control wiring maximum lengths shall be as shown below:

	CONDENSER TO EVAPORATOR UNIT	CONDENSER TO CENTRAL CONTROLLER	EVAPORATOR UNIT TO REMOTE CONTROL
CONTROL WIRING LENGTH	6,560ft (2,000m)	3,280ft (1,000m)	1640 ft. (500m)
WIRE TYPE	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

4. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest evaporator unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps or additional components.
5. Manufacturer’s approved piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

2.17 Heat Pump System Outdoor Condensing Unit

A. GENERAL:

1. The condensing unit is designed specifically for use with VRV series components.
6. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.
7. The refrigeration circuit of the condensing unit shall consist of inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator.
8. Liquid and suction lines must be individually insulated between the condensing and evaporator units.
9. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
10. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.
11. Each condensing system shall be able to support the connection of up to 64 evaporator units dependent on the model of the condensing unit.
12. The sound pressure level standard shall be that value as listed in the manufacturer's engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input.
13. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
14. The condensing unit shall be modular in design and should allow for side-by-side installation.
15. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
16. To ensure the liquid refrigerant does not flash when supplying to the various evaporator units, the circuit shall be provided with a sub-cooling feature.
17. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
18. The condensing unit shall be capable of heating operation at -13°F (-25°C) wet bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

B. UNIT CABINET:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.

C. FAN:

1. The condensing unit shall consist of one or more propeller type, direct-drive 700W fan motors that have multiple speed operation via a DC (digitally commutating) inverter. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and

shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.

2. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
3. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. SOUND:

1. Nominal sound pressure levels shall be 65 dB(A). Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps.

OPERATION SOUND dB(A)	NIGHT MODE SOUND PRESSURE LEVEL dB(A) APPROX.
Level 1	55
Level 2	50
Level 3	45

B. CONDENSER COIL:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM test standards.
5. The outdoor coil shall have a heat exchanger design that eliminates the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during heating operation enhancing the defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

C. COMPRESSOR:

1. The inverter injection scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value. Non-inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.

2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “K-type”.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 3.6% to 100% dependent on the model of the condensing unit.
5. The compressor’s motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be spring mounted to avoid the transmission of vibration eliminating the standard need for spring insulation.
9. In the event of compressor failure, the remaining compressors, if applicable, shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifold systems.

PART 3 EXECUTION

Part 3 Factory Testing

3.1 High Potential Testing

Upon completion of the air handler internal assembly, the fans shall be high potential tested for electrical connectivity. Power connection shall be connected to the motors by means of the VFD or junction box. Fans shall be verified for current draw, rotation direction, and RPM.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Air Conditioning & Refrigeration Institute (ARI)
 - .1 ARI 410-20, Forced-Circulation Air-Cooling and Air-Heating Coils.

1.3 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.
 - .2 Indicate the following:
 - .1 Equipment, capacity, piping, and connections.
- .3 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.
 - .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 Section 01 01 50 – General Instructions.

1.4 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

1.5 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 General

- .1 General: air coil certified by ARI 410.
- .2 Applications: hydronic or direct expansion (DX), as scheduled.
- .3 Capacity, pressure drop, dimensions as scheduled.
- .4 Maximum air velocity:
 - .1 Heating: 3.0 m/s (600 FPM).
- .5 Maximum operating pressure:
 - .1 Hydronic: 1,724 kPa (250 psi)
- .6 Factory tested at 2,172 kPa (315 psi) air pressure under water.

2.2 Construction

- .1 Tube: NPS 5/8 O.D., 0.51mm (0.02") thick seamless copper with 0.64 (0.025") thick bends. Water velocity selected at less than 1.2 m/s (4 ft/s).
- .2 Fins: 0.2mm (0.008") thick aluminum, mechanically bonded to tubes. Fin spacing shall not exceed 14 fins per inch.
- .3 Header: seamless copper with die formed collars for brazing coil tubes, vent and drain connection.
- .4 Casing: minimum 1.6mm (16 gauge) channel construction with flanges punched for mounted. Galvanized steel for heating coils and type 304 stainless steel for cooling coils. Provide intermediate tube support at 1,200mm (48") interval.
- .5 Connections: red brass, MPT connections.
- .6 Hydronic and DX coils shall have connections on the same side of header.

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 in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout.
- .3 Arrange coils for counter-flow of air and fluid.
- .4 Provide space for cleaning, servicing or removal of all coils.

- .5 For hydronic coils with vertical headers, arrange water entry at bottom to facilitate air removal.
- .6 Clean finned tubes and comb straight.
- .7 Provide unions at coil connections.
- .8 Provide dielectric fittings at dissimilar metal.
- .9 Clean finned tubes and comb straight.

3.3 Cleaning

- .1 Proceed in accordance with Section 01 01 50 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

AIR HANDLING UNITS						
Mark		AHU-1				
Service		Expansion				
Supply Fan	Supply Fan Air Flow - L/s (cfm)	1,584	3,356			
	Supply Fan External S.P. - Pa (in w.g.)	563	2.25			
	Supply Fan Size/Type	CP2-18				
	Supply Fan RPM Max RPM	2,079	3025			
	Supply Fan BHP Horsepower	3.75	5			
Return Fan	Return Fan Air Flow - L/s (cfm)	824	1,746			
	Return Fan External S.P. - Pa (in w.g.)	475	1.90			
	Return Fan Size/Type	CP2-14				
	Return Fan RPM Max RPM	1800	3,825			
	Return Fan BHP Horsepower	0.84	3			
DX Cooling Coil	Rows Fins per Inch	4	9			
	Air Flow - L/s (cfm)	1,584	3,356			
	Face Area - m ² (sq. ft)	0.64	6.88			
	Face Velocity - m ² /s (FPM)	41	488			
	Air P.D. - Pa (in w.g.)	118	0.473			
	Ent. Air Dry Bulb - °C (°F)	26.7	80.0			
	Ent. Air Wet Bulb - °C (°F)	19.4	67.0			
	Lvg. Air Dry Bulb - °C (°F)	13.7	56.6			
	Lvg. Air Wet Bulb - °C (°F)	12.6	54.6			
	Total Capacity - kW (MBH)	35.0	119.6			
Sensible Capacity - kW (MBH)	24.9	85.1				
Indirect Gas	Air Flow - L/s (cfm)	1,584	3,356			
	Input Capacity - kW (MBH)	43.9	150.0			
	Output Capacity - kW (MBH)	40.9	139.5			
	Ent. Air Temp - °C (°F)	11.1	51.9			
	Lvg. Air Temp - °C (°F)	32.5	90.4			
Minimum Outdoor Air - L/s (cfm)	528	1,119				
Filter Area - m ² (sq. ft.)	0.7	8.0				
Air Handler Main Electrical - MCA MOCP	11.0	15				
Air Handler Main Electrical Power - V Ph Hz	575 / 3 / 60					
Air Handler Service Electrical - MCA MOCP	12.0	15				
Air Handler Service Power - V Ph Hz	120 / 1 / 60					
Rooftop Unit Overall Weight - kg (lbs.)	2,900	6,380				
Notes (see the next page)	1, 2, 3, 4, 5, 6, 7					

AHU Heat Pump Section	Mark	HP-1				
	Refrigerant	R-410a				
	Ambient Temp °C (°F)	35.0	95.0			
	Nominal Total Cooling Capacity - kW (MBH)	35.2	120.0			
	Ducted EER IEER	11.1	19.0			
	Nominal Heating Capacity - kW (MBH)	39.6	135.0			
	Ducted Heating COP	3.5				
	Heat Pump Electrical - MCA MOCP	18.2	25			
	Heat Pump Power - V Ph Hz	575 / 3 / 60				
	Capacity Control Range - Min Max	11	100			

Refer to specification for accessories not scheduled. Refer to drawings for installation details.
 Heat pump heating conditions indoor 21°C(70°F)db/16°C(60°F)wb & outdoor 8°C(47°F)db/6°C(43°F)wb.
 Static pressures noted are external to the unit. Fan total pressure to include all cabinet effects as well as an allowance of 75 Pa (0.35" w.g.) for dirty filters. Motors to be sized so normal operating load is not more than 90% of rated motor capacity.

1. Complete with supply fan VFD and return fan VFD, single power connection, and disconnect.
2. Provide with separate 120V circuit to outdoor receptacle and marine lights inside unit for service.
3. Contractor shall provide insulated refrigerant piping between air handler DX coil and heat pump.
4. Single inverter compressor.
5. Merv 8 pre-filters upstream of coils.
6. Merv 14 final filters downstream of supply air fan.
7. Provide with 305mm (12") high roof curb that matches the footprint size of the air handler and heat pump mounted on a common base rail. Provide sheet metal cap under heat pump section to shed water off of the roof curb to the roof surface adjacent to the roof curb.

MAXIMUM SOUND POWER LEVEL SCHEDULE						
Mark	AHU-1 S/A	AHU-1 S/A		AHU-1 R/A	AHU-1 R/A	
Type	Fan Inlet	Fan Outlet		Fan Inlet	Fan Outlet	
LwA	84.0	91.0		74.0	81.0	
Octave Band (dBs re 10 ⁻¹² W)	63	76.0	75.0	65.0	65.0	
	125	76.0	81.0	65.0	69.0	
	250	86.0	96.0	76.0	80.0	
	500	80.0	87.0	70.0	76.0	
	1,000	76.0	82.0	67.0	77.0	
	2,000	75.0	78.0	67.0	74.0	
	4,000	75.0	76.0	66.0	69.0	
	8,000	73.0	72.0	61.0	62.0	

Mark	AHU-1 S/A	AHU-1 R/A	AHU-1 E/A	AHU-1 O/A		
Type	Floor Opening	Floor Opening	Back Opening	Side Opening		
LwA	79.0	74.0	78.0	79.0		
Octave Band (dBs re 10 ⁻¹² W)	63	64.0	64.0	59.0	66.0	
	125	71.0	63.0	64.0	67.0	
	250	85.0	74.0	76.0	78.0	
	500	75.0	69.0	73.0	74.0	
	1,000	70.0	66.0	74.0	70.0	
	2,000	67.0	67.0	71.0	70.0	
	4,000	65.0	66.0	66.0	70.0	
	8,000	61.0	61.0	59.0	68.0	

Mark	AHU-1 Casing	AHU-1 Floor				
Type	Radiated	Radiated				
LwA	58.0	57.0				
Octave Band (dBs re 10 ⁻¹² W)	63	57.0	54.0			
	125	64.0	52.0			
	250	66.0	64.0			
	500	46.0	53.0			
	1,000	35.0	46.0			
	2,000	28.0	37.0			
	4,000	27.0	30.0			
	8,000	24.0	21.0			

For return air paths, the required power is Inlet Power at the largest of any ducted inlet to the fan plenum, or Inlet Power of the fan itself when "fan inlet" is specified. In any case, the Lw data shall exclude any end reflection effects. For supply air paths, the required power is Outlet Power at the largest of any ducted outlet to the fan plenum, or Outlet Power of the fan itself when "fan outlet" is specified. In any case, the Lw data shall exclude any end reflection effects. Bare fan sound power level is acceptable in all cases. Test data shall be provided with the shop drawings to demonstrate that the above specification can be met. Identify AMCA Figure and Tests Setup used to determine the fan sound power levels provided. After the units are installed, at the prime consultant's option, acoustical tests will be undertaken to establish compliance with the above specification. The results shall be considered acceptable if they fall with 2 dB of the criteria (within 3 dB of the criteria is acceptable in the 63 Hz octave band). If the results are not acceptable, the contractor shall provide and install all treatments necessary to compensate for the deficiency, at no additional expense to the owner or his consultants. The contractor shall bear all additional charges for undertaking acoustical tests to confirm the acceptability of the additional treatment.

DUCT SILENCER

Mark	SIL-SA-AHU1		SIL-RA-AHU1					
Type	Elbow		Elbow					
Model	ERMTX88 / 2D		ERMTX92 / 6E					
Service	AHU-1 S/A		AHU-1 R/A					
Rectangle / Round	Rectangle		Rectangle					
Length - mm (in.)	2,235	88	2,337	92				
Overall Width - mm (in.)	762	30	610	24				
Overall Height - mm (in.)	711	28	610	24				
Net Airflow Width - mm (in.)	762	30	610	24				
Net Airflow Height - mm (in.)	406	16	305	12				
Diameter - mm (in.)								
Total Air Flow - L/s (cfm)	1,584	3,356	824	1,746				
Air Velocity - m/s (FPM)	5.1	1,007	4.4	873				
Installed P.D. - Pa (in w.g.)	35	0.14	18	0.07				
Dynamic Insertion Loss (dBs re 10 ⁻¹² W)	63	14	16					
	125	19	24					
	250	26	29					
	500	34	35					
	1,000	43	44					
	2,000	53	48					
	4,000	43	36					
	8,000	25	21					
Notes	1, 2		1, 2					

Mark								
Type								
Model								
Service								
Rectangle / Round								
Length - mm (in.)								
Overall Width - mm (in.)								
Overall Height - mm (in.)								
Diameter - mm (in.)								
Total Air Flow - L/s (cfm)								
Face Velocity - m/s (FPM)								
Max. P.D. - Pa (in w.g.)								
Dynamic Insertion Loss (dBs re 10 ⁻¹² W)	63							
	125							
	250							
	500							
	1,000							
	2,000							
	4,000							
	8,000							
Notes								

- 1 Complete with galvanized 16 ga. casing and 22 ga. perforated liner, glass fiber acoustic media with polymer film bagger
- 2 Horizontal installation orientation
- 3 Vertical installation orientation

Basis of design: EH Price. Approved manufacturers: EH Price, VAW Systems, Vibron, Vibro-Acoustics. Shop drawings of all silencers shall indicate requirements of this specification are met. The module size is required; overall dimensions and module orientation should be selected to minimize system turbulence. Attenuations in the bottom three bands are essential; attenuations in remaining bands acceptable if within 1 dB. "Max. P.D." refers to the maximum allowable pressure drop based on test results obtained under ideal test conditions with straight ductwork for three or more equivalent duct diameters upstream and downstream of the silencer. The values presented are based on the performance of the design model, with an allowance included for bidding. Where these maximum values cannot be satisfied, bidders shall request an approval from the Mechanical Consultant prior to submitting their bids. The length of a silencer is measured through its geometric centre.

EXHAUST FANS										
Mark	EF-7		EF-8		EF-9		EF-10		EF-11	
Type	Inline Cabinet		Inline Cabinet		Ceiling Exhaust		Centrifugal Roof		Centrifugal for Corrosive Air	
Service	Waiting & Med. Pickup		Staff Lounge		Maintenance Closet		Inmate WC		Biohazard Cabinet in Storage Rm.	
Air Flow - L/s (cfm)	146	310	90	190	24	50	47	100	24	50
External S.P. - Pa (in w.g.)	62.5	0.250	62.5	0.250	62.5	0.250	64	0.256	200	0.800
Power Consumed	3.11 FLA		0.71 FLA		0.34 FLA		0.02 BHP		1/3 HP	
Fan RPM	845		819		772		864		3440	
Sones dBA	0.4		1		0.3		2.7	41		74.4
Notes	1, 3, 4, 5, 6, 8		1, 3, 4, 5, 6, 8		1, 3, 4, 5, 7, 8		2, 3, 5, 8, 9		10, 11	
Mark	EF-12									
Type	Transfer Fan									
Service	Mechanical Room									
Air Flow - L/s (cfm)	106	225								
External S.P. - Pa (in w.g.)	25	0.100								
Power Consumed	4/25 HP									
Fan RPM	1982									
Sones dBA	2.5	-								
Notes	3, 7									

Refer to specification for accessories not scheduled. Fans suitable for 120/60/1 power.
 Refer to drawings for installation details.

1. Complete with galvanized steel housing, sound insulation, CSA motor.
2. Complete with aluminum housing, backward inclined wheel, birdscreen, CSA motor.
3. Complete with solid state speed control mounted and wired for air balancing purposes.
4. Complete with aluminum wheel material.
5. Complete with gravity operated back draft damper.
6. Complete with fan manufacturer's matching wall discharge terminal hood.
7. Complete with metal grille with white enamel finish.
8. Fan interlocked with air handler AHU-1.
9. Complete with manufacturer's roof curb minimum 305mm above finished roof surface, and curb seal.

CONSTANT AIR VOLUME AIR TERMINAL UNITS (Single Duct)										
Mark	CV- 1		CV- 2		CV- 3		CV- 4		CV- 5	
Area Served	Inmate Waiting		Exam. 103		Treatment 104		Dental Op.		Dental Reproc.	
Model	size 6		size 6		size 6		size 6		size 6	
Air Flow - L/s (cfm) - maximum	85	180	59	125	71	150	47	100	47	100
T.S.P. - Pa (in w.g.)	188	0.75	188	0.75	188	0.75	188	0.75	188	0.75
Entering Air Temperature °C (°F)	12.8	55	12.8	55	12.8	55	12.8	55	12.8	55
Leaving Air Temperature °C (°F)	37.2	99	33.3	92	35.6	96	38.9	102	38.9	102
Heating Cap. - kW (MBH)	2.5	8.6	1.5	5.0	2.0	6.7	1.5	5.1	1.5	5.1
Notes	1		1		1		1		1	

Mark	CV- 6		CV- 7		CV- 8		CV- 9		CV- 10	
Area Served	Optometrist		Workstations		Medication Rm.		Med. Pickup		Staff Lounge	
Model	size 6		size 8		size 6		size 6		size 6	
Air Flow - L/s (cfm) - maximum	47	100	354	750	90	191	47	100	76	161
T.S.P. - Pa (in w.g.)	188	0.75	188	0.75	188	0.75	188	0.75	188	0.75
Entering Air Temperature °C (°F)	12.8	55	12.8	55	12.8	55	12.8	55	12.8	55
Leaving Air Temperature °C (°F)	38.9	102	36.1	97	35.6	96	38.9	102	35.0	95
Heating Cap. - kW (MBH)	1.5	5.1	10.0	34.0	2.5	8.4	1.5	5.1	2.0	7.0
Notes	1		1		1		1		1	

Mark	CV- 11									
Area Served	Storage Room									
Model	size 6									
Air Flow - L/s (cfm) - maximum	94	199								
T.S.P. - Pa (in w.g.)	188	0.75								
Entering Air Temperature °C (°F)	12.8	55								
Leaving Air Temperature °C (°F)	34.4	94								
Heating Cap. - kW (MBH)	2.5	8.4								
Notes	1									

Units to be pressure independent and completed with air flow sensor.
 Radiated / discharge NC = 20 / 25.
 Electric coil capacities are selected for 600 V, 3 Ph power, unless noted otherwise.
 Coil section c/w access door.
 SCR controls with 0 - 10 Vdc input control signal from DDC.

Note:

1. Air terminal unit shall be constant air volume.

ELECTRIC DUCT HEATERS							
Mark	EDH-1		EDH-2				
Area Served	Corridor R13, etc		Ex. Mech R10				
Width - mm (in.)							
Height - mm (in.)							
Air Flow - L/s (cfm)	402	852	94	199			
	12.8	55	12.8	55			
	33.3	92	34.4	94			
Heating Cap. - kW (MBH)	10.0	34.0	2.5	8.4			
Weight - Kg (lbs)							
Voltage	600 V / 3 Ph		600 V / 3 Ph				
Amps							
Type of Controller	SCR		SCR				
Notes	3		3				

Electric Duct Heaters shall be as manufactured by Thermolec or approved equal. Refer to Specification for accessories not scheduled. Refer to drawings for installation details.

1. SC denotes Slip-in open coil type.
2. ST denotes Slip-in Tubular type.
3. FC denotes Flanged open coil type.
4. FT denotes Flanged Tubular type.
5. RFC denotes Round collar open coil type.
6. RFT denotes Round collar tubular type.

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 01 91 00 Commissioning
- .3 Section 23 08 00 Commissioning of Mechanical Systems

1.2 General

- .1 Provide, install, program and commission a BACnet-based DDC control system to achieve the performance specified in the following clauses.
- .2 Work covered by sections referred to above consist of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O Summaries.
 - .3 Data communications equipment necessary to effect an EMCS data transmission system including gateway and LAN hardware and software for connection to incumbent BACnet network.
 - .4 Field control devices.
 - .5 Software and graphics package complete with full documentation for software and equipment for system.
 - .6 1 stand alone user interface with keypad, which can be a site desktop or laptop PC at the contractor's discretion to fulfill the requirements.
 - .7 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.
 - .8 Acceptance tests, technical support during commissioning, full documentation.
 - .9 Wiring interface co-ordination of equipment supplied by others.
 - .10 Miscellaneous work as specified in these sections and as indicated.

1.3 Metric Reference

- .1 Conform to CAN/CSA-Z234.1.
- .2 Provide required adapters between Metric and Imperial components.

1.4 Standard Compliance

- .1 All equipment and material to be 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. Label or listing of specified organization is acceptable evidence.
- .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, 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 and specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.5 Submittals

- .1 Submit in accordance with Section 01 01 50 - General Instructions.
- .2 Provide schematic control diagrams for review. Each valve, actuator and instrument shall be given an identification label which will refer directly to control diagram.
- .3 Provide damper shop drawings which include data such as arrangement, velocities, and static pressure drops for each system on shop drawings.
- .4 Provide shop drawings including complete operating data, system drawings, wiring diagrams, and type written detailed operational description of sequences, and description and engineering data on each control system component.
- .5 At completion of work, make detailed check of automatic control system and submit written report to the Departmental Representative.
- .6 Provide sufficient copies of complete parts and repair manuals for binding in O&M Manuals.
- .7 Provide "record" control drawings and schedules; incorporate into O&M Manuals.
- .8 The submittals shall be prepared using the dynamic graphics software normally provided with system and be incorporated into the dynamic graphics system for on-line reference. Provide original, registered software disks of Windows, the Graphics Software package, the Operating System software, and the project graphic schematics, floor plan layouts, and control drawings.

1.6 Extra Materials

- .1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

1.7 Preliminary Design Review Meeting

- .1 Convene a Preliminary Design Review 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 Departmental Representative retains right to revise sequence or subsequent Control Description Logic prior to software finalization without cost to Departmental Representative.

1.8 Monitoring and Control Features

- .1 Operator defined digital and analogue alarms and automatic alarm condition reporting.
- .2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.
- .3 Addition, deletion, definition and modification of all points from operator keyboard.
- .4 Trend log graphing and reporting of user selected points at user defined intervals.
- .5 Run time logging of digital points.
- .6 Ability to accept a variety of standard analogue and digital input signals.
- .7 Ability to generate a variety of standard analogue and digital output signals.

1.9 Offline Storage

- .1 The DDC system shall have the capability to be taken off-line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually.
- .2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point. Use of the site desktop or laptop PC, if provided, for off-line storage is acceptable.

1.10 Power Surge Protection

- .1 The DDC system shall be protected from power line surges and voltage transients by installation of a power line filter.

1.11 Power Failure Protection

- .1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.
- .2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.
- .3 Outputs shall have the option of being set to "staggered start" upon power reset.

1.12 Electrical Components, and Conduit

- .1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified

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- sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.
- .2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 25.
 - .3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.
 - .4 Wiring is to be in conduit in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All wiring installed under this contract shall be plenum rated FT-6 or FT-4, if approved by all authorities having jurisdiction. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.
 - .5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.
 - .6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 26 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.
 - .7 Wire all line voltage thermostats, pressure switches or aquastats for single phase equipment.
 - .8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.
 - .9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 25 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications. Include for the supply and installation of 2 Cat 5 Ethernet, plenum rated cables from the hub location to the communications backboard. Coordinate with Division 26 and the Departmental Representative for interconnection of the hub or switch to the site network.

- .10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.
- .11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.
- .12 All shielded wiring will be grounded at the BMS panels and prevented from grounding at the terminal end.
- .13 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.
- .14 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.
- .15 Identify all junction boxes with control company label.
- .16 There are to be no splices in any of the control wiring except at devices or control panels.

1.13 Identification, Calibration and Programming

- .1 Provide a written sequence of operation for each piece of equipment or system being controlled that does not require knowledge of DDC programming. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.
 - .1 Procedures for daily operation of the system.
 - .2 Theory of operation of the equipment.
 - .3 Theory of operation of the control program.
- .2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.
- .3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:
 - .1 Point descriptor.
 - .2 Point type and channel number.
 - .3 Corresponding controller number.
- .4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well documented print out of the controller program for review.
- .5 At the time of the Departmental Representative's Demonstration and Instruction Period:
 - .1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.

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- .2 Submit CD's or USB flash drives (including back-up diskettes) containing up to date copies of the programs in each controller.
 - .3 Submit (2) two CD's or USB flash drives with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)
 - .4 Provide the original software CD's or USB flash drives and the users manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and desktop computer the software has been installed on. The controls contractor shall be responsible for registering all software with the manufacturer in the Departmental Representative's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.
 - .6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:
 - .1 A report indicating all work performed.
 - .2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.
 - .3 Update printed and electronic copies of any changes made to programs for any controller.
 - .7 Provide two days of on-site instruction to the Departmental Representative during the first year of operation, scheduled as requested by the Departmental Representative, during one or more of the 2 visits.

1.14 Controller Software

- .1 Each stand alone control panel shall contain a complete software development system in each panel. The software development system shall consist of a menu driven, prompted programming language containing complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application specific programming of each individual stand alone control panel.
- .2 Four user access levels shall be provided with a user access code available at each level. Each level shall permit identifiable multiple user access.
- .3 Point names shall be defined using a minimum of 128 alphanumeric characters to provide an English language description of the point function.
- .4 The stand alone control panel shall be capable of generating sorted alarm, trend log, energy management, maintenance time remainder, and exception log reports on a prioritized basis. Segregated report generation shall be invoked by manual request, time of day, calendar, accumulated run time, or event occurrence.
- .5 DDC Control:
 - .1 The network of stand alone control panels shall individually perform setpoint reset, ramping functions, 2-position ON/OFF control, PID loop control, linear sequencing, rotating sequencing, binary sequencing,

HI/LO/AVE selection, energy dead band, and thermostat controls as required to control their connected systems of equipment.

- .6 Energy Management Control:
 - .1 The network of stand alone control panels shall individually perform time of day scheduling, optimum start/stop, enthalpy optimization, trend logging, demand limiting and all control optimization strategies, such as supply air reset, and soft ramp-up, for their connected systems of equipment.
 - .2 Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone control panels on the communicating network.
- .7 Facilities Management Control:
 - .1 The Departmental Representative shall be provided the ability to read out temperatures and other values and to adjust specific items from localized location. Every controller shall provide the following reports:
 - .2 Facility Diagnostics
 - .1 The facilities management system shall provide diagnostic reports for selected systems of equipment as specified.
 - .3 Alarm Occurrence Status
 - .1 When specified alarm conditions occur, provide a report available to printout, listing the status of specific items associated with the equipment generating the alarm. Report shall be routed through auto dial out feature to a specific printer or combination of printers. Report shall record the time the status information was taken, and shall allow operational personnel to use this information to diagnose the alarm situation.
- .8 SAC and Micro Controller Trend Logs:
 - .1 Controllers shall be capable of storing up to twenty-five (25) full trend logs with a minimum of 200 data samples each. They shall be able to collect and store samples of the value of any system variable (i.e. temperature). The operator shall be able to create a trend log, with each trend log containing up to 4 points. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The ability to graphically display to 4 points on the screen simultaneously, print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.
- .9 Network communication/controllers Trend Logs:
 - .1 Trend logs shall be provided to collect and store samples of the value of a point i.e., temperature. The network communication/controllers shall have sufficient memory to create and store 200 full trendlogs. Each BacNet trendlog shall be capable of monitoring 1 I/O or virtual point from any controller or combination of controllers across the network, and storing a minimum of 2000 data samples for each trended point. The sample

frequency shall be selectable for each trend log between 1 second and 24 hours. The network communication/controllers shall be capable of archiving the trended data to the Host computer or dialing out to a remote trend computer and downloading the data automatically. The ability to indefinitely retain the contents of a trend log in the controller or automatically transfer the contents of a trend log to disk storage, or printer and restart the log shall be provided.

- .10 Host Level Trending:
 - .1 Shall be provided to collect and store samples of the value of any system variable (i.e. temperature Trend Logs: Shall be provided to collect and store samples of the value of any system variable. The operator shall be able to create a BACnet trend log, with each trend log containing 1 point. The sample frequency shall be selectable for each trend log between 1 second and 99 hours. The ability to link multiple single point BACnet trend logs to be displayed on an 8 point Multi-trend log for comparative analysis shall be provided. Ability to print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.
- 11. The stand alone system with user interface with keypad terminal shall provide all features listed above.

1.15 Computer Graphics Software

- .1 Incorporate the following standards for the required host capabilities and installed features:
 - .1 The host computer operator interface, network interface and graphical interface software shall be Microsoft Windows based.
 - .2 Provide one licensed copy of the complete HOST software package complete with operating manuals, installation manuals, setup manuals, programming manuals, and original diskettes.
 - .3 Host operator interface.
- .2 The following functionality shall be available to the operator from either the onsite host, or colour laptop connected to anywhere on the network inside the building. These workstations shall operate as graphic interface devices. Attention must be paid to developing an interface to the system using a minimum of user keystrokes. The primary user interface must be the mouse.

Provide functionality such that any of the following may be performed simultaneously, at either workstation and in any combination, via user-sized windows.

 - .1 Dynamic color graphics and graphic control
 - .2 Alarm management and control
 - .3 Time of day scheduling
 - .4 Trend data definition and presentation
 - .5 Graphic definition

- .6 Graphic construction
- .7 Database functions
- .3 Graphic generation and design:
 - .1 Provide a default graphic consisting of a visual overview of the entire control system. The display shall be in a tree format. Indicate the various branches of graphic access available from the tree for each mechanical system and building zone. The site plan of the facility should be used as a reference tree to show the relationship of each system to a particular building zone. Graphic links for each zone must be available to allow the user to link directly to the desired graphic or step systematically forward or backward through the tree to each graphic associated with the mechanical system. The operator must be able to return directly to the default from any level of graphic menu penetration.
 - .2 As a minimum, provide the following graphic screens and dynamic linking:
 - .1 A default graphic to be used as a central starting point for penetrating the menu of available graphic screens.
 - .2 Zone summary graphic. Dynamically indicate zone high select (Hsel) and low select (Lsel) temperatures, AHU supply air temperatures and setpoints, and status of the air handling units serving the zone.
 - .3 Dynamic graphic floor plans for each building zone, scaled appropriately to be readable from a laptop. Indicate room temperatures, architectural room number, control valve position, supply fan system serving the area, and any associated equipment such as exhaust fans, fume hoods, etc. From this screen the operator shall be able to command the control valve, adjust the room setpoint, access the graphic screen for the supply fan system, view a trend log of the room temperature, or access a graphic for associated mechanical equipment.
 - .4 A schematic of each mechanical system. As a minimum, each graphic will indicate all DDC I/O points and software variables associated with each system. Indicate the DDC point names, current status value, and operator priority.

All graphic screens shall be created using the same software supplied to the Departmental Representative. Provide the graphic data files in a format suitable for inclusion into the graphical operator interface and for direct loading into the graphic editor. The graphic data files shall be the sole property of the Departmental Representative.

DEFAULT GRAPHIC COLOURS			
Normal On	GREEN	Text Arial 12 pt	BLACK
Heating Equipment	RED	Normal Off	BLACK
Background	WHITE	Cooling Equipment	BLUE
Ducts	BLACK	ALARM	RED
Sensors	BLUE		

.4 Graphical
links:

- .1 All system graphical links will be located in the upper left corner of the screen. These links will be displayed in sequential order representative of the menu tree.

1.16 Related Work

- .1 The following incidental work shall be furnished by the mechanical sub-contractor under the supervision of the controls subcontractor:
- .1 Installation of control dampers including duct transitions, assembly and interconnection of multiple section dampers.
 - .2 Supply and installation of sheet metal baffles as required to eliminate air stratification.
 - .3 Supply and installation of access panels for service and installation of control equipment.
 - .4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

PART 2 PRODUCTS

2.1 Site Desktop PC

- .1 The user interface with keypad provided by the contractor on site for the proposed EMCS software installation can be a desk top or laptop computer, at the contractor's discretion, in order to fulfill the EMCS requirements.
- .2 Contractor shall confirm new computer can be used for the new EMCS software.

PART 3 EXECUTION

3.1 General

- .1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.
- .2 Install damper motors on outside of ducts. Do not locate in outside air stream.
- .3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.
- .5 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.
- .7 Permanently identify each wire, cable, conduit and tube at each terminal.
- .8 Wiring and tubing shall be identified at each DDC panel by termination number.

Wiring and tubing shall be identified at terminal device by termination and DDC panel numbers.

- .9 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.
- .10 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.
- .11 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Enclosure and Conduit

- .1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.
- .2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.
- .3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.
- .4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.
- .5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.
- .6 Provide EMT conduit with set screw metal fittings where wiring is exposed and in all mechanical rooms. All conduit will be piped smoothly and neatly following building lines. Wiring above accessible ceilings and in wall cavities may be run free-air.
- .7 Liquid-tight flexible conduit to be used for rooftop unit wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof rooftop unit curb.
- .8 All junction boxes will have covers properly and firmly affixed after installation completion.

3.3 I/O Wiring

- .1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.
- .2 Use plenum cable where required.
- .3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.
- .4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.
- .5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.

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- .6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip.
 - .7 Low voltage I/O wiring may be mixed together within a conduit. Low and line voltages may not be mixed together within a conduit.

3.4 Power Wiring

- .1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer's specification.
- .2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.
- .3 Power wiring shall not be mixed with I/O wiring in a conduit.

3.5 LAN Wiring

- .1 Provide LAN wiring as per manufacturer's specification.
- .2 For EIA-485 LAN wiring, use low capacitance shielded #18-2 or #22-2 cable.
Ensure that each contiguous section of shield is terminated at a single point.

3.6 Control System Commissioning

- .1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.
- .2 The contractor is to supply digital point and non digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non digital.
- .3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.
- .4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.
- .5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.
- .6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Authority prior to the contractor's verification at least three months before the scheduled substantial completion of the project.

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- .7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative, Commissioning Agent and Commissioning Authority, in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.
 - .8 The commissioning contractor is not to commence controls checks until the above documentation is received. The Temperature Control Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Temperature Control Supplier for the purchase price of the material.
 - .9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.
 - .10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Temperature Control Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 31 – Commissioning (CX) Plan.
 - .11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 25 05 01 EMCS: General Requirements

1.2 References

- .1 Canadian Standards Association (CSA)
 - .1 C22.2 No.205, Signal Equipment.
- .2 Institute of Electrical and Electronics Engineers
 - .1 IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

1.3 Maintenance Procedures

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Requirements.

1.4 Submittals

- .1 In accordance with Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Requirements. Submit product data sheets for each product item proposed for this project.

PART 2 PRODUCTS

2.1 System Descriptions

- .1 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.
- .2 Provide a means to ensure communication integrity. At a minimum indicate for each controller in system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.
- .3 The system will display an error message, in the event of a communication error.
- .4 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.
- .5 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points, and continue to control the systems based on those values. Failure of any controller, or any part of a

controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.

- .6 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the naming convention of the incumbent system.

2.2 Memory

- .1 Each controller shall have enough random access memory for all of the following:
 - .1 Variables - ONE (1) for each hard point connected to the controller.
 - .2 PID Controllers - TWO (2) for each analogue output point connected to the controller.
 - .3 Weekly Schedules - ONE (1) for every major system connected to the controller.
 - .4 Annual Schedule - ONE (1) for the entire LAN.
 - .5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.
 - .6 Runtime Logs - ONE (1) for each digital hard and soft point.
 - .7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

2.3 Processing Speed

- .1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.
- .2 Provide a peer to peer high speed local area network (LAN) capable of supporting as many controllers as required to meet the minimum point capacity of the system as specified elsewhere. The network shall permit synchronization of all real time clocks, and the automatic transferring of the value of points from one controller. All BACnet MSTP system LANs shall operate at a communication speed in excess of 76K baud. Provide Bacnet Ethernet communication backbone operating at 10 mega baud. Provide a minimum of 1 [one] BACnet Building Controller [B-BC] for each main mechanical room Network communication/controllers shall be provided in sufficient numbers and memory configurations to meet the specified operational trending and system network access and performance requirements without utilizing the Host Computer.

2.4 Building Controllers

- .1 Building Controllers shall reside on the main LAN or highest level of communication.
- .2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.

- .3 In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem and intelligent thermostat communications.
- .4 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.
- .5 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.
- .6 Controllers will accommodate a maximum of 160 universal I/O points on board using a single address.
- .7 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.
- .8 All outputs must have optional HOA on board for easy override by non DDC users.

2.5 Local Terminal Capability

- .1 The user interface with keypad shall have full access to the entire system including programming and shall interface at any primary or micro controller point in the system. Provide remote floor location connections so that all points are within 50m maximum of a terminal access point. The system shall be capable of supporting multiple local operator terminals. The operator's terminal shall be capable of performing the following functions:
 - continuous display of labelled, system variables
 - network wide, password controlled access
 - setpoint and parameter adjustment
 - setting and clearing of timed and permanent overrides
 - acknowledging system alarms
 - stand alone controller program uploads, and downloads.
 - viewing alarm and exception logs
 - graphical and textual display of all physical points
 - graphical and textual display of trended data
 - dynamic system schematics
 - full system programming revisions/changes including database modifications

2.6 VAV Controller

- .1 VAV Controller (BACnet overview): A VAV Controller is VAV terminal unit controller with integral damper actuator and on-board differential pressure based flow measurement.
 - .1 Data Sharing - Ability to provide the values of any of its BACnet objects and Ability to allow modification of some or all of its BACnet objects by another device.
 - .2 Device and Network Management - Ability to respond to information about its status.
- .2 VAV Controllers shall be used for dual duct mixing boxes and single duct air terminal units.

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- .3 VAV Controllers shall communicate on the main LAN or subLAN using EIA-485 (MSTP). In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.
 - .4 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller. Firmware based programming will be accepted.
 - .5 Provide 120v-24vac transformers for controls.

PART 3 EXECUTION

3.1 General

- .1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .2 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.
- .3 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .4 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 01 50 General Instructions
- .2 Section 25 05 01 EMCS: General Requirements

1.2 References

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13, Requirements for Instrument Transformers.
- .2 National Electrical Manufacturer's Association (NEMA)

1.3 Submittals

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Requirements.
- .2 Include:
 - .1 Information as specified for each device.
 - .2 Manufacturer's detailed installation instructions.
- .3 Pre-Installation Tests
 - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .4 Manufacturer's Instructions
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 Closeout Submittals

- .1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Requirements.

PART 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 °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 to be unaffected by external transmitters (eg. 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 3R enclosures.
- .8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 Averaging Duct Sensors

- .1 Shall be installed in all mixed air ducts and/or plenums, discharge air ducts and/or plenums, or any duct and/or plenum where stratification occurs.
- .2 Shall have a minimum length of 1.5 meters with a duct and/or plenum cross sectional area of .75 square meters or less, and a minimum length of 6 meters for duct and/or plenum cross sectional areas in excess of .75 square meters.
- .3 The sensor shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.
- .4 Accuracy: plus or minus 0.05 °C at 21 °C.
- .5 Minimum sensing range: -40 °C to 40 °C.

2.3 Duct Sensors

- .1 Shall be installed in all ducts and/or plenums where stratification of the air flow does not occur.
- .2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.
- .3 Minimum length: 203mm.
- .4 Accuracy: plus or minus 0.2% over its operating range.
- .5 Minimum sensing range: 4.5 °C to 60 °C.

2.4 Immersion Sensors

- .1 Shall be complete with a brass immersion well.
- .2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.
- .3 Accuracy: plus or minus 0.05 °C at 21 °C.
- .4 Minimum sensing range: -40 °C to 40 °C.

2.5 Room Temperature Sensors

- .1 Shall have a blind cover for all applications. Provide a secured temperature sensor for public areas.
- .2 Shall have a thermister sensing element producing a linear output over its sensing range.
- .3 Accuracy: plus or minus 0.2% over its operating range.
- .4 Minimum sensing range: 4.5°C to 35°C.

2.6 Differential Pressure Sensors (DPS)

- .1 Shall vary the output voltage with changes in differential pressure.
- .2 End to end accuracy: not less than +1% of span including non-linearity, repeatability and hysteresis.
- .3 Application: building pressurization control shall have auto-zeroing feature.

2.7 Current Sensors (CT)

- .1 Shall vary the output voltage with a change in current.
- .2 Provide actual analog current indication for status of all motors 1 horsepower and larger.
- .3 In software provide multiple switch points to determine both motor status and belt breakage. Size for inrush and F.L.A.
- .4 Provide alarm indication for high and low current.
- .5 Provide digital current indication for all motors 3/4 HP and smaller by using current switches (CS) which shall open or close a contact from motor induced current to indicate motor status.

2.8 Motion Detector (MD):

- .1 Shall be utilizing microwave and PIR technology plus a micro controller, using adaptive threshold technology to provide false alarm immunity.
- .2 Sensor shall have electronic temperature compensation and microwave pattern shaping to match the PIR pattern.
- .3 Mounting location, model and number of detectors to be in accordance with manufacturer's recommendations.

2.9 Airflow Measuring Station:

- .1 Thermal dispersion airflow measuring station. Bead-in-Glass thermistors, waterproof epoxy sensor, 304 stainless steel mounting, FEP plenum rated cable, microprocessor-based with high performance A/D converter, 2% sensor airflow accuracy, 0 to 5,000 FPM airflow operating range, -20°F to 160°F temperature operating range, 24VAC power supply; analog, RS-485 and Ethernet (BACnet Ethernet, TCP/IP) output.

2.10 Control Valves and Actuators

- .1 Provide automatic temperature control valves as scheduled and indicated on drawings. Sufficient clearance above control valves shall be provided to allow removal of superstructure without removing body from line. All valve stems shall be vertical. All electric valves, including zone valves, scheduled for modulating service shall be fully proportional (no floating control) suitable for 0-10 volt, or 4-20 mA input signal.
- .2 Control valves, both 2 and 3 way configuration, shall have the following minimum characteristics:
 - .1 Body shall be brass meeting ANSI Standard B16.15 Class 250 for all valves 50 mm and smaller. Larger valves shall be cast iron, Class 125, meeting ANSI Standard B16.15.
 - .2 Valve stem shall be 316 stainless steel.
 - .3 Valves shall have brass plug, composition seat with maximum seat leakage of 0.01% of flow rating per ANSI B16.104, and equal percentage flow characteristic.
 - .4 Valves for terminal zone coils, fan coils and radiation shall have EPT or TFE packing material and NPT, union or flare connections.
 - .5 Valves for primary equipment sized 50 mm and smaller shall have screwed connections. Valves sized 65 mm and larger shall have flanged connections.
 - .6 Ball Valves are not acceptable for control applications.
- .3 When more than one control valve is used for temperature or pressure control on a system, or equipment item they shall be sequenced. e.g. two valves on a heating coil or pressure reducing station; heating and cooling coil valves on an air handling system.
- .4 Valves on hazardous services shall fail to a safe position. e.g. Valves controlling heating to domestic hot water shall fail closed to heating when not powered.
- .5 Actuators shall be of the rotary or piston type for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Control voltage shall be either 120 VAC, 24 VAC, 10 VDC, or 4-20 mA with spring return on power failure, where required. (ie outdoor air dampers and HVAC primary heating valves). Actuators (motors) shall have repair kits available, and be re-buildable in the field. Provide proportional actuator position feedback on all primary equipment (air handling units) to prove actuator position.
- .6 All control valves shall have replaceable bonnets, and packing. The packing shall be replaceable in the field without having to remove the valve from the piping network.
- .7 All control valves shall be sized to deliver the specified flow rate in the 100% open position. Control valves using a "limited stroke" to achieve the proper flow coefficient shall not be used.

2.11 Dampers and Actuators

- .1 All control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor. Provide damper actuators for all dampers shown or specified.
- .2 All dampers in a mixing application shall be parallel blade with direction of closing producing opposed air streams for optimal mixing. Return air dampers shall be a tight closing, low leakage type with replaceable blade and edge seals, T.A. Morrison Series 1000 or approved equal.
- .3 Actuators shall be electronic, direct coupled, as manufactured by Belimo, Siemens, or Approved Equal. Control voltage shall be 0-10 VDC, or 4-20 mA with an internal spring return on power failure. Provide a 2-10 VDC proportional actuator position feedback signal on all primary equipment (air handling units, relief air and emergency generators) to prove actuator position. Actuators shall permit manual positioning of damper when actuator is not powered.

PART 3 EXECUTION

3.1 General

- .1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.
- .2 Install damper motors on outside of ducts. Do not locate in outside air stream.
- .3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .4 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .5 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.
- .6 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.
- .7 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Sensors

- .1 Sensors provided shall be installed in accordance with the Manufacturer's prescribed procedures.
- .2 Sensors shall be rigidly mounted and mountings shall be adequate for the environment within which the sensor operates.

- .3 Averaging type temperature sensors shall be used wherever mixed air or stratified temperature is to be monitored. They shall be installed in a serpentine configuration with adequate provision for the mechanical protection of the sensor and such that it is supported as required along its entire length.
- .4 Duct type Thermistors shall be used for the monitoring of all uniform air temperature. Length shall be such that the sensing element is installed to not less than one third of the duct width or duct diameter from the duct wall.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 25 05 01 EMCS: General Requirements

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 Sequence of Operation

- .1 Air Handling Unit, AHU-1:
 - .1 The DDC control system shall switch the system from "occupied" to "unoccupied" mode of operation and shall allow override capability from the room sensor to restore "occupied" mode of operation. The room sensor shall maintain reduced temperature during "unoccupied" periods and shall be integrated with the system optimal start feature.
 - .2 During "occupied" mode of operation the outdoor air damper and return air dampers shall be positioned as determined by the balancing contractor to provide the scheduled minimum outdoor air volume, except during economizer control.
 - .3 During the heating season, the heat pump system shall provide heat to maintain room temperature set point. When the ambient outdoor air temperature gets too cold for the heat pump to maintain an AHU-1 supply air temperature of 16°C (60°F, adjustable), the gas fired heater shall be used instead. The AHU-1 mixed air temperature shall be maintained at the highest temperature allowable without causing overheating or allowing the outdoor air volume to fall below the minimum setting. Upon demand for cooling the heating systems shall be disabled.
 - .4 The DDC shall enable the condensing unit and provide outputs to the remote condensing unit controller, which provide discharge air control with reset from the DDC. The mixed air temperature shall be maintained at the highest temperature allowable without causing overheating or allowing the outdoor air volume to fall below the minimum setting. The mixed air temperature of the air handling system shall be limited to a minimum of 12.8°C (55°F) during a demand for cooling. Coordinate with condensing unit manufacturer on controls.
 - .5 When the outdoor air temperature is above the return air temperature, the modulating outdoor air damper shall revert to the minimum outdoor air damper position and the condensing unit shall be staged to maintain the required supply air temperature to prevent overheating.
 - .6 The outdoor air dampers are to remain closed during the morning warm-up period until the return air temperature is 20° C.
 - .7 Air handling unit is to run continuously during "occupied" mode of operation and are to cycle to maintain a reduced temperature with the outdoor air damper remaining closed during "unoccupied" periods. An optimal start program shall control the morning start-up of all air handling

-
- unit to reach the "occupied" temperature set point at the required time. The calculation shall compensate for outdoor air temperature, actual indoor air setback temperature, and warm up period required, based upon past performance. Under "heating" mode of control the start up shall be delayed as long as possible. Under "cooling" mode of control, the unit shall start and run on 100% outdoor air when appropriate to pre-cool the building to set point temperature using free cooling.
- .8 Provide ASHRAE Cycle II low limit control for the economizer dampers. If the mixed air temperature exceeds a high limit or falls below a low limit the outdoor air damper shall maintain the normal minimum ventilation set point (ASHRAE II) until the mixed air return to normal.
 - .9 Provide analog pressure differential sensor across each filter bank and monitor status of fan operation and filter pressure drop for each air handling unit.
 - .10 Provide all field wiring including power wiring from disconnect switch to motor terminal block.
 - .11 For each zone provide room temperature sensor to sequence reheat or duct heater control upon a demand for heating. Monitor supply air temperature downstream of reheat and duct heater coils.
- .2 Constant Air Volume Air Terminal Controllers:
- .1 Furnish and install a DDC electronic control system for the control and monitoring of constant air volume air terminal units.
 - .2 The control system enclosures shall be made of material that is suitable for use in ceiling plenum applications.
 - .3 The DDC electronic control system shall consist of a local control panel, enclosures, damper actuator, differential pressure transducer, space temperature controller.
 - .4 The DDC system shall be capable of controlling pressure independent, single duct, constant air volume air terminal unit complete with independently sequenced reheat.
 - .5 A proportional damper actuator shall be directly mounted on the air terminal unit damper shaft. The actuator drive speed shall be variable and the actuator travel shall be continuously adjustable to prevent damage to terminal boxes due to over torquing. The damper actuator shall be configurable for clockwise or counter-clockwise primary air damper operation. The damper operator shall have adequate torque to properly operate damper from full open to full closed position.
 - .6 Air flow shall be measured and controlled by a multi-point averaging differential pressure transmitter, in accordance with the variable air volume box manufacturer's specifications. The flow transmitter shall contain an automatic on-line recalibration circuit that eliminates transducer errors due to temperature and long term sensor drift.
 - .7 The zone temperature shall be controlled by a controller with automatic self-tuning proportional and integral (P+I) action. The temperature controller shall be complete with setpoint adjustment capability by the room occupant and occupancy override to restore the day temperature setpoint.
 - .8 The zone temperature controller shall be capable of automatically changing over from heating mode to cooling mode to satisfy the space demand based on the supply air temperature conditions. The controller

shall have separate, independent PID loop algorithms complete with its own tuning parameters for both the heating and cooling modes of operation.

- .9 The zone temperature controller shall control the primary air damper and terminal reheat in sequence to maintain zone temperature.
- .10 The temperature control system shall have night set back capability for each zone.
- .11 The central control panel shall monitor and control the electronic control system on each variable air volume terminal unit.
- .12 The terminal box controller shall automatically revert to stand alone control mode in the event of a central control panel communication failure. Upon re-establishment of network communications, the terminal box controller shall automatically revert back to central control.
- .13 The terminal box controller shall be capable of reporting the following parameter values to the central control system:
 - Room space temperature.
 - Supply duct temperature of each air terminal unit.
 - Instantaneous terminal flow velocity.
 - Room temperature setpoint.
 - Occupied/unoccupied status.
 - Damper position.
 - Self-diagnostics information.
 - Heating output for electric re-heat boxes.
 - Space temperature cooling setpoint.
 - Space temperature heating setpoint.
 - Airflow setting (CFM).
 - Night setback.
 - Night setup.
 - Overrides.
- .14 The central management system shall be capable of changing the following operating parameter values for each terminal box controller.
 - Space temperature cooling setpoint.
 - Space temperature heating setpoint.
 - Airflow setting (CFM).
 - Night setback.
 - Night setup.
 - Overrides.
- .15 Provide air terminal unit controllers, temperature sensors, and duct static pressure sensor to achieve the following sequence of operation. The controller shall be supplied to the air terminal unit manufacturer for factory installation.

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- .16 The duct static pressure sensor shall be located at the remote end of the main supply air duct (exact location to be determined by the Controls Contractor).
 - .17 Monitor air volume and supply air temperature at the DDC system. Provide an alarm at the DDC when the temperature exceeds or drops below set point.
 - .18 When the AHU is disabled, the damper shall remain closed.
 - .19 When the AHU is enabled, the damper shall open. The DDC system shall send a signal to the air terminal unit controller to maintain constant air volume at all time. The damper will modulate to maintain the duct static pressure and air volume as the filters at the AHU unit become loaded.
 - .20 The controller at reheat coil shall modulate to maintain space temperature.
- . 3 Exhaust Fans:
- .1 EF-1 through EF-6 are existing exhaust fans and their respective control shall remain as is; not started, stopped or monitored at the DDC.
 - .2 EF-7, EF-8, EF-9, and EF-10 shall be started, stopped and monitored at the DDC. Interlock each exhaust fan to operate when air handler AHU-1 operates.
 - .3 EF-11 shall be started, stopped and monitored at the DDC. Fan shall operate continuously during normal operation.
 - .4 EF-12 shall be started, stopped and monitored at the DDC. Transfer fan shall operate when space temperature exceeds 25°C (adjustable) set point. Alarm to DDC if room temperature exceeds alarm high temperature set point of 30°C (adjustable).
- .4 Optimal Start Program
- .1 An optimal start program shall control the morning start-up of all air handling units to reach the "occupied" temperature set point at the required time. The calculation shall compensate for outdoor air temperature, actual indoor air setback temperature, and warm up period required, based upon past performance. Under "heating" mode of control the start up shall be delayed as long as possible. Under "cooling" mode of control, the unit shall start and run on 100% outdoor air when appropriate to pre-cool the building to setpoint temperature using free cooling. The outdoor air dampers are to remain closed during the morning warm up period until the return air temperature is 20°C.
- .5 Low Temperature Protection
- .1 All air supply systems shall be fitted with a hard wired manual reset, adjustable setting, low limit thermostat which shall stop system fans when temperatures below set point, normally 4°C, are sensed. Monitor status of all low temperature thermostats.

- .6 Domestic Hot Water Recirculation Pump Control
 - .1 Domestic hot water recirculation pump (P-DHWR) shall be switched by the building DDC control system to control pump operation in accordance with time of day schedule. The domestic hot water return temperature shall be monitored by DDC.
 - .2 Provide current transformer to monitor status of circulating pump.

- .7 Sensor Operated Plumbing Fixtures
 - .1 The Plumbing contractor shall furnish the sensor operated plumbing fixture controls and transformer. The Electrical contractor shall power the transformer. The Controls contractor shall connect the plumbing fixture sensor to the automatic valve and low voltage power per the manufacturer's recommendations. See plumbing drawings and specifications for quantity and locations. The sensor operated plumbing fixtures include sinks, lavatories, urinals and water closets.

3.2 Point List

- .1 The following point lists are typical of the Analog and Digital output and input points required to achieve the intended sequence of operation and provide the required level of monitoring and control. They are intended to set a minimum level of acceptability. All additional points required to achieve the specified features and sequence of operation shall be provided by the control contractor.

.2

AIR HANDLING UNIT, AHU-1							
POINT DESCRIPTION	POINTS				ALARM/INDICATION		
	A	AO	DI	DO	HI	LO	FAIL
SUPPLY FAN START/STOP/STATUS	CT			CR			X
RETURN FAN START/STOP/STATUS	CT			CR			X
SUPPLY AIR TEMPERATURE	DTS				X	X	
MIXED AIR TEMPERATURE	ATS					X	
MIX AIR DAMPER		DMA					
GAS HEATING VALVE							
HEAT PUMP UNIT START/STOP/STATUS	CT			CR			X
HEAT PUMP UNIT ALARM			X				X
HEAT PUMP UNIT DISCHARGE AIR TEMP. CONTROL AND RESET		X					
FILTER STATUS	DPS				X		
LOW LIMIT TEMPERATURE			LTS			X	
RETURN AIRFLOW	FSA	POT					
RELIEF AIR		DMA					
ZONE COILS (TYP.)		VMA					
ZONE COIL DISCHARGE TEMP (TYP.)	DTS					X	
OUTDOOR AIR TEMPERATURE	OTS						

.3

AIR TERMINAL UNITS AND DUCT HEATERS, TYPICAL							
POINT DESCRIPTION	POINTS				ALARM/INDICATION		
	AI	AO	DI	DO	HI	LO	FAIL
SUPPLY AIR TEMPERATURE	DTS				X	X	
AIRFLOW	FAS	DMA					
DAMPER		DMA					
REHEAT CONTROL		VMA					
ROOM TEMPERATURE	RTS				X	X	

.4

EXHAUST FANS, TYPICAL							
POINT DESCRIPTION	POINTS				ALARM/INDICATION		
	AI	AO	DI	DO	HI	LO	FAIL
FANS (START/STOP/STAT)	CT			CR			X

.5

DOMESTIC HOT WATER SYSTEM							
POINT DESCRIPTION	POINTS				ALARM/INDICATION		
	AI	AO	DI	DO	HI	LO	FAIL
DHWH-1 (BACnet Points)	X		X	X	X	X	X
EWB-1 (BACnet Points)	X		X	X	X	X	X
FMV-* (TYPICAL)	WTS				X	X	
DOMESTIC HOT WATER (TYPICAL)	WTS				X	X	
DOMESTIC HOT WATER RECIRCULATION PUMP (P-DHWR) START/STOP/STAT	CT		CR				X

NOTE: POINT COUNT IS APPROXIMATE. CONTROLS CONTRACTOR SHALL VERIFY EXACT QUANTITY AND PROVIDE ADDITIONAL POINTS AS REQUIRED TO ACHIEVE THE SEQUENCE OF OPERATION DESCRIBED IN THE CONTRACT DOCUMENT.

- | | | |
|----------------------------------|----------------------------------|------------------------------|
| ATS Averaging Temperature Sensor | DPS Diff. Press. Switch (Analog) | OTS Outdoor Air Temp. Sensor |
| ASD Adjustable Speed Drive | DTS Duct Temperature Sensor | POT Potentiometer |
| CDS Carbon Dioxide Sensor | DHS Duct Humidity Sensor | R-ST Relay Status |
| CS Current Switch | ES End Switch | RHS Room Humidity Sensor |
| CR Digital Relay | FSA Flow sensor - Air | RTS Room Temperature Sensor |
| CT Analog Current Transformer | FSW Flow sensor - Water | VMA Valve Motor (Analog) |
| DCI Dry Contact Input | LTS Low Temperature Switch | VMD Valve Motor (Digital) |
| DHS Duct Humidity Sensor | MOP Proportional A.O. (4-20 ma) | VPM Variable pump motor |
| DMA Damper Motor (Analog) | MD Motion Detector | WTS Water Temperature Sensor |
| DMD Damper Motor Digital | O-SW Override Switch | |

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Materials and installation for subsoil drainage piping.

1.2 Related Sections

- .1 Section 31 23 10 Excavation, Trenching and Backfilling

1.3 References

- .3 Canadian Standards Association (CSA International)
 - .1 CSA B1800, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .2 CSA B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .3 CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).
 - .4 CSA B182.11, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.4 Definitions

- .1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with the manufacturer's recommendations.

1.6 Waste Management and Disposal

- .1 Remove from site and dispose of packaging materials at appropriate disposal facilities.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations, and Division 2 specifications.
- .4 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials and Division 2 specifications.

PART 2 PRODUCTS

2.1 Subsoil Drain Piping

- .1 Perforated rigid drainage pipe: Polyvinyl Chloride (PVC) to CSA-B182.2.

- .2 Standard Dimensional Ratio (SDR): 35.
- .3 Pipe stiffness: 320 kPa at 5% deflection, ASTM D2412.
- .4 Fitting: solid hub by hub.
- .5 Size: 150mm [6"] unless otherwise noted.

2.2 Cleanout

- .1 Extended ferrule, Dura-Coated cast iron body with gas and water tight ABS countersunk plug.

PART 3 EXECUTION

3.1 Preparation

- .1 Clean and dry pipes and fittings before installation.
- .2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.2 Excavation

- .1 Do excavation work in accordance with Section 31 00 99.
- .2 Do not place birds-eye gravel material prior to approval of subbase by Departmental Representative.

3.3 Pipe Bedding and Cover

- .1 Subsoil drain shall be laid to on 150 mm drain gravel and covered with 250mm of drain gravel measured from the top of pipe, unless otherwise shown or specified. Do not place material in frozen conditions.
- .2 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.
- .3 Shape transverse depressions in bedding as required to suit joints.
- .4 Fill excavation below design elevation to bottom of specified bedding in accordance with Section 31 23 33 with backfill material.

3.4 Installation

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 Handle pipe using methods approved by the Departmental Representative. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

- .2 Correct pipe which is not in true alignment and grade or pipe which shows differential settlement after installation great than 10 mm in 3 meters.
- .3 Subsoil drain shall be laid continuous and even falls of not less than 0.5% unless otherwise noted.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by the Departmental Representative.
- .7 Install plastic pipe and fittings in accordance with CSA B182.11.
- .8 When stoppage of work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .9 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .10 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available. Stabilize pipe at openings made in rock pit manhole with shrinkage compensating grout.
- .11 All changes in direction shall be made with solid hub by hub fittings. Vertical drops shall be solid with a minimum of 100mm [4"] gravel curtain around pipe. Branches will be taken off with Y's and catch basin connections shall be made with one length of cast iron pipe.
- .12 Provide cleanouts at changes in direction, extended to terminate flush with grade.
- .13 Where noted on drawing, provide geotextile materials.

END OF SECTION

Appendix 3

List of Equipment to be Relocated and Installed by Contractor

Appendix 4

List of Equipment to be Purchased and Installed by Contractor

