

CONSULTANTS – SEAL & SIGNATURE

Discipline

Seal / Signature / Date

Mechanical
(Prime)



2020-05-26

Electrical



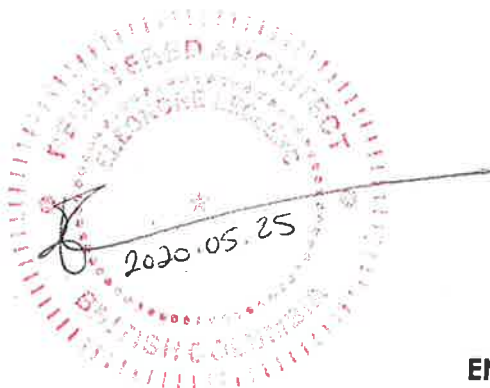
Z Chen

2020/05/26

Structural



Architectural



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END OF PROJECT DRAWING LIST

PART 1 General

1.1 SUMMARY OF WORK

- .1 Work covered by Contract Documents:
 - .1 This Contract covers the following work at the Chilliwack Correctional Centre located in Chilliwack, BC.
- .2 Work to be performed under this Contract includes, but not limited to, the following items covered further in the Contract documents.
 - .1 Provide a detailed work plan including a project schedule and phasing. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service.
 - .2 Do not start work until all essential equipment is delivered to the site and the work can proceed without delays.
 - .3 Provide as-built drawings and closeout submittals.
 - .4 Refer to Section 01 11 00 Summary of Work.
- .3 Contractor's Use of Premises:
 - .1 Contractor has limited use of site for work of this contract until Substantial Completion:
 - .1 Contractor use of premises for storage and access, as approved by the Departmental representative.
 - .2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
 - .2 Vehicular access will be restricted during the inmate "count" at breakfast, lunch, and dinner hours. Confirm times with Departmental Representative. Delays may occur when entering and exiting the Institution with vehicles due to security situations and heavy traffic.

1.2 WORK RESTRICTIONS

- .1 Service Interruptions
 - .1 Notify Departmental Representative of intended interruption of power, communication and water services and provide schedule of interruption times.
 - .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of services throughout course of work. Keep duration of interruptions to a minimum. Coordinate interruptions with local Authority Having Jurisdiction and local residences and businesses affected by the disruption.

- .2 Access & Egress: Provide for access by pedestrian and vehicular traffic on and around site where work is in progress.
- .3 Use of Site and Facilities
 - .1 Execute work with least possible interference or disturbance. Make arrangements with Departmental Representative to facilitate work as stated.
 - .2 Maintain existing services where indicated and provide for personnel and vehicle access.
 - .3 Where security is reduced by Work, provide temporary means to maintain security.
 - .4 Contractor to provide sanitary facilities. Keep facilities clean.
 - .5 Closures: protect Work temporarily until permanent enclosures are completed.
- .4 Security Requirements: refer to Section 01 14 10 Security Requirements (CSC).
- .5 Hours of work:
 - .1 Perform work during normal working hours of the Institution 07:30 to 16:00, Monday through Friday except holidays.
 - .2 When it is necessary, arrange in advance with Departmental Representative to work outside of normal working hours.

1.3 CONSTRUCTION WORK SCHEDULE

- .1 Commence work immediately upon official notification of acceptance of offer and complete the work within 18 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 Submittal:
 - .1 Submit to Departmental Representative within 10 working days of Award of Contract, a Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of construction progress.
 - .2 Identify each trade or operation.
 - .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 bi-weekly 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 bi-weekly 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. Only PWGSC paperwork is acceptable.

1.4 SUBMITTAL PROCEDURES

- .1 Specified in Section 01 33 00 Submittal Procedures.

1.5 HEALTH AND SAFETY

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

1.6 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 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .5 Under no circumstances dispose of rubbish or waste materials on adjoining property.

1.7 REGULATORY REQUIREMENTS

- .1 References and Codes:
 - .1 Perform Work in accordance with National Building Code of Canada (NBCC-2015) including all amendments up to bid closing

date, British Columbia Building Code (BCBC-2018), and other codes of provincial or local application provided that in case of conflict or discrepancy, the more stringent requirements apply.

- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes, and referenced documents.

1.8 QUALITY CONTROL

- .1 Specified in Section 01 45 00 Quality Control.

1.9 TEMPORARY UTILITIES

- .1 Installation and Removal:
 - .1 Provide temporary utilities controls in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .2 Fire Protection:
 - .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations, and bylaws.

1.10 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 Hoisting:
 - .1 Provide, operate, and maintain hoists required for moving of workers, materials, and equipment. Make financial arrangements with Subcontractors for use thereof.
 - .2 Hoists to be operated by qualified operator.
- .3 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.
- .4 Construction Parking:
 - .1 Make good damage to existing roads used for access to project site.

- .2 Build and maintain temporary access where required and provide snow removal during period of Work.
- .3 Park vehicles outside perimeter fence in designated parking areas.
- .5 Contractor's Site Office and enclosure:
 - .1 Provide office of size to accommodate site meetings and Contractor's operations.
 - .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
 - .3 Provide temporary fenced area to enclose site and operations.
- .6 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.
- .7 Sanitary Facilities:
 - .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
 - .2 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures. Permanent facilities may be used on approval of Departmental Representative.

1.11 TEMPORARY BARRIERS AND ENCLOSURES

- .1 Hoarding:
 - .1 Erect temporary site enclosure using new 1.8 m high temporary construction fencing. Provide lockable truck gate. Maintain fence in good repair.
- .2 Enclosure of Structure:
 - .1 Provide temporary weathertight enclosures and protection for exterior openings until permanently enclosed. Design enclosures to withstand wind pressure. Provide lockable entry as required for moving personnel equipment and materials.
 - .2 Provide temporary enclosures to secure building from entry of unauthorized personnel during construction period.
- .3 Guardrails and Excavations:
 - .1 Provide secure, rigid guard rails and barricades around deep excavations, open edges of floors and roofs etc.

- .2 Provide as required by governing authorities.
- .4 Access to Site:
 - .1 Maintain immediate local access roads in clean condition used during work of this contract.
- .5 Protection for Off-Site and CSC Property:
 - .1 Protect surrounding CSC property from damage during performance of Work.
 - .2 Be responsible for damage incurred.
- .6 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.

1.12 COMMON PRODUCT REQUIREMENTS

- .1 Reference Standards:
 - .1 If there is 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:
 - .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 neither to damage nor to put at risk any portion of Work.
- .10 Location of Fixtures:
- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
 - .2 Inform Departmental Representative of conflicting installation. Install as directed.
 - .3 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 governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.
- .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, capped and re-routed services lines.

.15 Contractors Options for Selection of Products:

- .1 Products specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.
- .2 Products specified under "Acceptable Products" (used for complex Mechanical or Electrical Systems): select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.
- .3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.
- .4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Instructions to Bidders".
- .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

.16 Substitution after award of Contract:

- .1 No substitutions are permitted without prior written approval of the

Departmental Representative.

- .2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.
- .3 Proposals will be considered by the Departmental Representative if:
 - .1 products selected by tenderer from those specified are not available;
 - .2 delivery date of products selected from those specified would unduly delay completion of Contract, or
 - .3 alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.
- .4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.
- .5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

1.13 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.

1.14 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 purpose made saw or core drill. Pneumatic or impact tools not allowed on brittle materials 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 firestopping 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.

1.14 CLEANING

- .1 Specified in Section 01 74 11 Cleaning.

1.15 WASTE MANAGEMENT AND DISPOSAL

- .1 Specified in Section 01 74 19 Waste Management and Disposal.

1.16 CLOSEOUT PROCEDURES

- .1 Specified in Section 01 77 00 Closeout Procedures.

1.17 CLOSEOUT SUBMITTAL

- .1 Specified in Section 01 78 00 Closeout Submittals.

1.18 GENERAL COMMISSIONING

- .1 Specified in Section 01 91 13 General Commissioning Requirements.

1.19 DEMONSTRATION AND TRAINING

- .1 Specified in Section 01 91 41 Commissioning Training.

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract includes:
- .1 Removal and replacement of existing HVAC systems, equipment, and components – Fans F-9, F-15, F-16, F-20 [formerly MUA-1]), Pump P-4, and gravity hoods.
 - .2 Removal and replacement of existing heating coils HC-1, HC-2, and circulation pumps P-3 and P-4. Modify piping arrangement.
 - .3 Removal and replacement of existing HVAC control systems, equipment, hardware, components, and conduit. Modify graphics and programming.
 - .4 Removal and replacement of existing roof curbs and sleepers.
 - .5 Removal and replacement of existing electrical equipment, wiring, and conduit.
 - .6 Removal and replacement of existing roofing membrane system on lower flat roofs.
 - .7 Provide new heating coil HC-4 and circulation pump P-7.
 - .8 Provide new structural systems to support new HVAC systems.
 - .9 Provide new roof curbs and sleepers for HVAC equipment.
 - .10 Provide new utility stairs at roof access hatch.
 - .11 Perform roof and wall modifications, repair, and patching.
 - .12 Patch and make good all damage caused by mechanical and electrical work.
 - .13 Commission and test all new HVAC, controls, and electrical systems.

At the Chilliwack Correctional Centre in Chilliwack, BC and further identified as the "Work".

1.2 WORK SEQUENCE

- .1 Construction period shall be determined in coordination with the Departmental Representative.
- .2 Maintain fire access/control.

1.3 CONTRACTOR USE OF PREMISES

- .1 Access to this site is restricted and will need to be coordinated with the facility's site officer to perform the work.
- .2 Co-ordinate use of premises under direction of Departmental Representative.

- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.4 EXISTING SERVICES

- .1 Notify Departmental Representative, governing authorities and utility companies of intended interruption of services and obtain required permission.
- .2 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active services including power and communications services. Adhere to approved schedule and provide notice to affected parties.

1.5 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy of each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 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.

1.2 PURPOSE

- .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 (.1) to (.4) above 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 or Warden of the Institution as applicable or their representative.
- .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 zone" 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.

1.3 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' responsibilities:
 - .1 Ensure that all construction employees are aware of the CSC security requirements.
 - .2 Ensure that a copy of the CSC 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.

1.4 CONSTRUCTION EMPLOYEES

- .1 Submit scanned copy of government issued ID for each employee to the Departmental Representative to obtain gate pass.
- .2 Allow 10 working days for processing of gate passes. Employees will not be admitted to the Institution without a gate pass in place and a recent picture identification such as a provincial driver's license.
- .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 Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the construction employees clothing at all time while employees are at 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.

1.5 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. All storage trailers inside and outside the perimeter must be locked when not in use.

1.6 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.

1.7 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 for the contractor.

1.8 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, PDAs, 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.

1.9 WORK HOURS

- .1 Work hours within the Institution are generally 7:30am to 16:00 with some exceptions. Refer to Division 1 and coordinate with Director for exceptions.
- .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.

1.10 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.

1.11 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 toolboxes 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 temporary heating during construction, the institution will require that the contractor supervise the construction site during non-working hours.

1.12 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 will 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.

1.13 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.

1.14 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.

1.15 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.

1.16 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.

1.17 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.

1.18 ACCESS AND REMOVAL FROM INSTITUTION PROPERTY

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

1.19 MOVEMENT VEHICLES

- .1 Construction vehicles are not to leave the Institution until an inmate count is completed. Escorted commercial vehicles will be allowed to enter or

leave the institution through the vehicle access gate during the following hours:

- .1 AM: 0745 hrs. to 1100 hrs.
- .2 PM: 1300hrs. to 1530 hrs.
- .2 The contractor will advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .3 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.
- .4 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.
- .5 Vehicles will 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.
- .6 Private vehicles of construction employees will not be allowed within the security wall or fence without the authorization of the Director.
- .7 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.

1.20 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 or PWGSC Construction Escort Officer.
- .3 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the Institution cafeteria and dining room.

1.21 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.

1.22 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 will note the name of the staff member giving the instruction, the time of the request and obey the order as quickly as possible.
- .2 The contractor shall advise the Departmental Representative of this interruption of the work within 24 hours.

1.23 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 Digital cameras (or any other type) are not allowed on CSC property.
- .3 Notwithstanding the above paragraph, if the director approves of the use of cameras, it is strictly 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.

1.24 COMPLETION OF CONSTRUCTION PROJECT

- .1 Upon completion of the construction project or, when applicable, the takeover of a facility, the Contractor shall remove all remaining construction material, tools and equipment that are not specified to remain in the Institution as part of the construction contract.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Division 5 – Metals
- .3 Division 7 – Thermal and Moisture Protection
- .4 Division 9 – Finishes
- .5 Division 21, 22, 23 – Mechanical
- .6 Division 26 – Electrical

1.2 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. 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.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present shop drawings, product data, samples, and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 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 co-ordinated 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.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.
- .11 Maintain a submittal log.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 14 working days for Departmental Representative's review of each submission.
- .4 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of any revisions other than those requested.
- .6 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of

- field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
 - .8 After Departmental Representative's review, distribute copies.
 - .9 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
 - .10 Submit one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product. Notwithstanding the foregoing, submit full shop drawings including but not limited to the following items: toilet partitions, washroom accessories (provide layout drawing), detention and commercial doors and frames, detention windows, and chain link fencing.
 - .11 Delete information not applicable to project.
 - .12 Supplement standard information to provide details applicable to project.
 - .13 Shop drawings will be reviewed by the Departmental Representative for general conformance with the design concept of the project and general compliance with information given in the Contract Documents. The Departmental Representative will signify the status of the review by stamping and dating the electronic copy accordingly, in one of the following manners:
 - .1 Reviewed
 - .2 Reviewed as Noted
 - .3 Revise and Resubmit
 - .4 Not Reviewed

- The Departmental Representative will return the electronic copy to the Contractor for their use and for copying for record keeping purposes and for distribution to Subcontractors and to suppliers.
- .14 The Contractor shall distribute copies of the returned shop drawings by the Departmental Representative as **"Reviewed," "Reviewed as Noted"** to the Site Office and to the offices of Subcontractors, and suppliers.
 - .15 Shop drawings stamped **"Revise and Resubmit"** or **"Not Reviewed"** will be returned and shall be corrected and resubmitted to the Departmental Representative following the requirements stated above.
 - .16 Only shop drawings stamped **"Reviewed"** and **"Reviewed as Noted"** shall be used on the site and used for fabrication and installation of work. All other shop drawings shall be considered as being not reviewed and shall not be used on site or for fabrication and installation of work.
 - .17 Conform to review comments and stamped instructions of each shop drawing reviewed.
 - .18 Only drawings noted for revision and re-submission need be resubmitted. Include revisions required by previous reviews before re-submission of shop drawings.
 - .19 No new details or information shall be added to shop drawings after they have been fully reviewed.
 - .20 No work dependent on shop drawing information shall proceed until review is given and verification received from the Departmental Representative. Be responsible for work performed prior to receipt of reviewed shop drawings. No review comments shall be construed as authorization for Changes in the Work.
 - .21 Each Subcontractor or supplier shall fabricate work exactly as shown on shop drawings and if shop practice dictates revision, shall revise shop drawings and resubmit.
 - .22 File one copy of each finally revised and corrected shop drawing on site.
 - .23 Consider this article the minimum requirement. Further instruction contained in any particular specification section governs for that section of the Work.
 - .24 Shop drawings must be in Metric measurement.
 - .25 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept. This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents.

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

- .26 The Contractor will have a system in place to allow the Departmental Representative, Contractor and its Subcontractors to have electronic access to the project submittals, shop drawings, project communication and latest drawings on file through an internet site. The Contractor and its Subcontractors are required to access the system to obtain the latest drawings on which their shop drawings will be based. If shop drawings are submitted based on outdated drawings shop drawings will be returned without further action. The users of the electronic system, once entered into the system, will be informed electronically of updated drawings available to them on the system. Photocopies of the Departmental Representatives design drawings will not be accepted.
- .27 The Departmental Representative's CADD files shall not be used by the Contractor, its Subcontractors, or Suppliers for use in preparing shop drawings.
- .28 A copy of final reviewed shop drawings in electronic format shall be included in operating and maintenance manuals specified under Section 01 78 00.

1.4 **SAMPLES**

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to site office.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 **CERTIFICATIONS**

- .1 When specified in individual specification sections, submit certification by manufacturer to the Departmental Representative to indicate material or

Product conforms to or exceeds specified requirements.

- .2 Certificates may be recent or previous test results on material or Product, but must be acceptable to the Departmental Representative.

1.6 MANUFACTURER'S FIELD REPORTS

- .1 Submit reports for the Departmental Representative's benefit as contract administrator.
- .2 Submit reports in duplicate within 10 days of observation, to the Departmental Representative for information.
- .3 Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.7 PROGRESS DIARY

- .1 Keep a permanent, written record on the site of the progress of the Work. Keep record open to the inspection of the Departmental Representative, and copies shall be furnished to the Departmental Representative upon request.
- .2 The diary shall record all pertinent data such as:
 - .1 Daily weather conditions.
 - .2 Commencement, progress, and completion of various portions of the Work.
 - .3 Dates of all site meetings.
 - .4 Dates of visits or inspections by government authorities, inspectors, utility companies and any other visitors to the site.
 - .5 Record of work force employed.
 - .6 Information required by Contractor or Subcontractor. Clarifications requested and answers received.
 - .7 Materials causing delay.
 - .8 Actions or events causing delay.
- .3 Record of all quality control inspections and fire safety inspections including corrective actions taken.

1.8 PHOTOGRAPHS

- .1 When requested by the Departmental Representative: Provide an electronic photographic record/history of the progress of the Work, per the Departmental Representative's instructions.

1.9 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation

Board status.

- .2 Submit transcription of insurance immediately after award of Contract.

END OF SECTION

GENERAL

PWGSC Update on Asbestos Use

Effective April 1, 2016, all Public Works and Government Services of Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit use of asbestos-containing materials.

COVID 19

All contractors shall follow Canadian Construction Association COVID-19 - Standardized Protocols for All Canadian Construction Sites.

1.1 REFERENCES

- .1 Government of Canada.
 - .1 Canada Labour Code - Part II (as amended)
 - .2 Canada Occupational Health and Safety Regulations. (as amended)
- .2 National Building Code of Canada (NBC): (as amended)
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electrical Code (as amended)
- .4 Canadian Standards Association (CSA) as amended:
 - .1 CSA Z797-2018 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-2016 Falsework for Construction Purposes.
 - .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
 - .4 CSA Z1006-10 Management of Work in Confined Spaces.
 - .5 CSA Z462-18 Workplace Electrical Safety Standard
- .5 National Fire Code of Canada 2015 (as amended)
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .6 American National Standards Institute (ANSI): (as amended)
 - .1 ANSI/ASSP A10.3-2013, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .7 Province of British Columbia:
 - .1 Workers Compensation Act Part 3-Occupational Health and Safety. (as amended)
 - .2 Occupational Health and Safety Regulation (as amended)

1.2 RELATED SECTIONS

- .1 Refer to the following current NMS sections as required:
 - .1 Section 01 01 50 General Instructions (CSC)
 - .2 Section 02 41 19 Selective Demolition

1.3 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.

1.4 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.

1.5 SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 01 50.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Organizations Health and Safety Plan.
 - .2 Site Specific Safety Plan or Health and Safety Plan (SSSP or HASP)
 - .3 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .4 Copies of incident and accident reports.
 - .5 Complete set of Material Safety Data Sheets (SDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .6 Emergency Response Procedures.

- .4 The Departmental Representative will review the Contractor's Site Specific Safety Plan or Health and Safety Plan (SSSP/HASP) and emergency response 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.
- .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 Site Specific Safety Plan or 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.

1.6 RESPONSIBILITY

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .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 and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

- .1 Assign a competent and qualified Health and Safety Coordinator who shall:
 - .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 Safety Plan (SSSP) or Health and Safety Plan (HASP)
 - .3 Be on site during execution of work.

- .4 Have minimum two (2) years' site-related working experience
- .5 Have working knowledge of the applicable occupational safety and health regulations.

1.8 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 at night time or provide security guard as deemed necessary to protect site against entry.

1.9 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.
 - .3 Energized electrical services.
 - .4 Working from heights.
 - .5 Hazards - PWGSC Preliminary Hazard Assessment included as an Appendix to Specifications

1.10 UTILITY CLEARANCES

- .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.
- .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for Utility locations.

1.11 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.

1.12 WORK PERMITS

- .1 Obtain specialty permit(s) related to project before start of work.

1.13 FILING OF NOTICE

- .1 The General Contractor is to file Notice of Project with Provincial authorities prior to commencement of work. (All construction projects require a Notice of Work)
- .2 Provide copies of all notices to the Departmental Representative.

1.14 SITE SPECIFIC 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 the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) based on the required 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 record keeping procedures.
 - .11 COVID 19 Protocols and 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. SDS required for all products.
 - .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 Site Specific Safety Plan (SSSP) and/or Health and Safety Plan (HASP) as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Site Specific Safety Plan and/or Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Safety Plan and/or Health and Safety Plan of responsibility for meeting all requirements of construction and Contract documents and legislated requirements.

1.15 EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an emergency response and emergency 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.
 - .5 A route map with written directions to the nearest hospital or medical clinic.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, 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 or residences 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.
 - .5 Work on, over, under and adjacent to water.
 - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.
- .6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.16 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Safety Data Sheets (SDS) 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 SDS and WHMIS 2015 documents as per Section 01 01 50.
 - .2 In conjunction with Departmental Representative schedule to carry out work during "off hours" when tenants have left the building.
 - .3 Provide adequate means of ventilation in accordance with Section 01 51 00.
 - .4 The contractor shall ensure that the product is applied as per manufacturers recommendations.

- .5 The contractor shall ensure that only pre-approved products are bought onto the work site in an adequate quantity to complete the work.

1.17 ASBESTOS HAZARD

- .1 Carry out any activities involving asbestos in accordance with current applicable Federal and Provincial Regulations.
- .2 Removal and handling of asbestos will be in accordance with current applicable Provincial / Federal Regulations.

1.18 PCB REMOVALS

- .1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.
- .2 Remove, handle, transport and dispose of as indicated in Division 2 specifications.

1.19 REMOVAL OF LEAD-CONTAINING PAINT

- .1 All paint containing TCLP lead concentrations above 5 ppm are classified as hazardous.
- .2 Carry out demolition and/or remediation activities involving lead-containing paints in accordance with current applicable Provincial / Territorial Regulations.
- .3 Work with lead-containing paint shall be completed as per Provincial and Federal regulations.
- .4 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.
- .5 The use of Methylene Chloride based paint removal products is strictly prohibited.

1.20 ELECTRICAL SAFETY REQUIREMENTS

(Reference: Worksafe BC OHS Regulation Part 19 – Electrical Safety)

- .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 arc flash protection, 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.

1.21 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.

1.22 OVERLOADING

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

1.23 FALSEWORK

- .1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003) (as amended)

1.24 SCAFFOLDING

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 (as amended) and B.C. Occupational Health and Safety Regulations. (as amended)

1.25 CONFINED SPACES

- .1 Carry out work in compliance with current Provincial / Territorial regulations.

1.26 POWDER-ACTUATED DEVICES

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

1.27 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.

- .3 Hot Work permits are a mandatory requirement for any hot work activities.

1.28 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. (as amended)
- .3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the Departmental Representative is required prior to any gas or diesel tank being brought onto the work site.

1.29 FIRE PROTECTION AND ALARM SYSTEM

- .1 Fire protection and alarm systems shall not be:
 - .1 Obstructed.
 - .2 Shut off.
 - .3 Left inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.30 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 immediately advise the Departmental Representative verbally and in writing.

1.31 POSTED DOCUMENTS

- .1 Post legible versions of the following documents on site:
 - .1 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)
 - .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 plans or site plans. Must be posted in a non-inmate access area and locked up when not being used.
 - .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 2015) documents.
 - .9 Material Safety Data Sheets (SDS).
 - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
 - .11 All Hazardous Material and Substance Reports including Lab Analysis
- .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.

1.32 MEETINGS

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

1.33 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 noncompliance of health and safety regulations is not corrected immediately or within posted time. The General contractor / subcontractors will be responsible for any costs arising from such a "stop work order".

2 PRODUCTS

- .1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

Part 1

General

1.1

SECTION INCLUDES

- .1 Inspection and testing, administrative, and enforcement requirements.
- .2 Quality control program.
- .3 Equipment and system adjust and balance.

1.2

RELATED SECTIONS

- .1 Section 01 01 50 – General Instructions (CSC).
- .2 Section 01 33 00 – Submittal Procedures.
- .3 Section 01 78 00 – Closeout Submittals.

1.3

GENERAL

- .1 At Project commencement, establish quality assurance benchmarks and quality expectations for all workers and Subcontractors to follow.
- .2 The Specification identifies a minimum level of quality, exceed this minimum level.
- .3 Identify a person in the employ of the Contractor to monitor Work quality and to report quality assurance steps being taken, identified, or discovered disparities, and corrective action taken.
- .4 Submit written reports monthly to the Departmental Representative, to accompany progress claims.
- .5 Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- .6 Comply with manufacturer's instructions, including each step in sequence. Should manufacturer's instructions conflict with Contract Documents, request clarification from Departmental Representative before proceeding.
- .7 Comply with specified standards as minimum quality for the work except where more stringent tolerance, codes, or specified requirements indicate higher standards or more precise workmanship.
- .8 Perform work with persons qualified to produce required and specified quality.

1.4

QUALITY CONTROL PROGRAM

- .1 Prepare all test results in triplicate and provide copies of all tests concurrently to the Departmental Representative and Contractor.
- .2 All test results shall specify at least the following data:
 - .1 Type of test.

- .2 Dates of sampling, testing and reporting.
- .3 Personnel involved.
- .4 Location of test (with sketch if required).
- .5 Specified requirements.
- .6 Test results.
- .7 Remarks regarding conformance with Contract Documents.
- .3 Provide written test results to the Departmental Representative within 12 hours of tests. If the tests are completed on Site, provide the Departmental Representative with field memo summarizing results immediately following testing.
- .4 Minimum testing requirements shall be in accordance with all applicable bylaws, regulations, standards, building codes and requirements of Authority Having Jurisdiction.

1.5 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 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.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections, or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 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.

1.6 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by the Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.
 - .1 Submit for approval by Departmental Representative proposed Independent Inspection/Testing Agencies.

- .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 cost to Departmental Representative. Pay costs for retesting and re-inspection.

1.7 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.8 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.

1.9 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.

1.10 REPORTS

- .1 Submit digital copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested manufacturer or fabricator of material being inspected or tested.

1.11 MILL TESTS

- .1 Not applicable.

1.12 TEST AND MIX DESIGNS

.1 Not applicable.

1.13 MOCK-UPS

.1 Not applicable.

1.14 EQUIPMENT AND SYSTEMS

.1 Submit testing, adjusting, and balancing reports for mechanical and electrical systems.

.2 Submit commissioning reports for mechanical and electrical systems.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 74 19 - Waste Management and Disposal.
- .2 Section 01 77 00 - Closeout Procedures.
- .3 Section 02 41 19 - Selective Demolition.

1.2 REFERENCES

- .1 Work Safe B.C. Regulations.

1.3 SPECIAL CLEANING

- .1 Special cleaning requirements for existing construction, including existing work which will be covered up by new work and existing work to remain as is in the finished work.

1.4 SPECIAL CLEANING PERFORMANCE REQUIREMENTS

- .1 Existing building construction remaining part of the finished work will require a complete and thorough cleaning before installation of new construction and finishes. Existing construction remaining unaltered by the new work but forming part of the finished work is required to be cleaned.
- .2 Cleaning includes but is not limited to all interior walls, floor and ceiling surfaces including concealed spaces such as attics, access floor, walls, and soffits above accessible ceilings. Clean existing fittings, fixtures, equipment, doors, frames, electrical outlets, lights, cabinets, diffusers, panels, glazing, and metalwork.
- .3 Remove all dirt, dust, sawdust, aggregate dust, mildew, moulds, fungus, insects, and other foreign materials to return the existing surface to an as new condition as much as possible. Removal of permanent stains is not a requirement unless the stain is unsuitable for the application of new finishes or is odourous.
- .4 The cleaning method selected will depend on the surface to be cleaned, its condition at the time of cleaning, the material to be removed by the cleaning process, and the requirements for new construction or finish to be applied.
- .5 Cleaning methods can include but are not limited to hand cleaning, power tool cleaning. Steam cleaning and pressure washing are not acceptable in the existing institution.
- .6 The method of cleaning and the cleaning products to be used will be left entirely to the discretion of the Contractor to suit the surface to be cleaned.
- .7 Where the method is disruptive to the operation of the existing facility, review and obtain approval from the Departmental Representative. The Contractor is advised that the work will be carried out within an existing

operational building. The materials and processes must not disrupt the existing persons or operations within the institution. If required, the cleaning must be carried out on a schedule acceptable to the institution.

- .8 The Contractor will be responsible for repair of finishes and materials damaged during cleaning where aggressive cleaning methods result in damage to finishes and materials.
- .9 Prepare a test patch clean on a surface to be concealed prior to commencing work on an entire area or surface.
- .10 The Contractor will be responsible for repair of damage or replacement of existing surfaces and finishes where in appropriate cleaning products and methods have been used.
- .11 Where existing construction cannot be cleaned effectively by available cleaning methods, obtain direction from the Departmental Representative.
- .12 The requirements of this section are in addition to the requirements of specification trade sections which prescribe the preparation and/or acceptance of existing surfaces before the application of new finishes. Ensure that cleaning products to be used do not affect the occupants of the building and do not affect the application of new finishes to existing cleaned surfaces.

1.5 **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.
- .3 Make arrangements with and obtain permits from Authority Having Jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.
- .6 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .7 Dispose of waste materials and debris off site.
- .8 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.6 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 and debris including that caused by Departmental Representative or other Contractors.
- .5 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.
- .6 Make arrangements with and obtain permits from Authority Having Jurisdiction for disposal of waste and debris.
- .7 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.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres, and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps, and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.

- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.7 DEMOLISHED MATERIALS AND CONSTRUCTION WASTE

- .1 The Contractor is responsible for ensuring that all materials are properly disposed of and that under no circumstances are demolished materials, construction waste, screws, fasteners, connectors, and other similar items to be left in walls, ceilings, cavities, pockets, and voids.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 In accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Separate waste materials for recycling or dispose of waste in accordance with:
- .2 In accordance with Section 02 41 19 Selective Demolition.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 01 50 – General Instructions (CSC)
- .2 Section 01 14 10 – Security Requirements
- .3 Section 01 35 30 – Health and Safety Requirements
- .4 Division 2 – Existing Conditions

1.2 DEFINITIONS

- .1 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .3 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .4 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .5 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modeling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .6 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .7 Separate Condition: Refers to waste sorted into individual types.
- .8 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.
- .9 Waste Audit (WA): Detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction. Indicates quantities of reuse, recycling, and landfill.
- .10 Waste Reduction Workplan (WRW): Written report which addresses opportunities for reduction, reuse, or recycling of materials.

1.3 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Audit.
 - .2 Waste Reduction Workplan.
 - .3 Material Source Separation Plan.

1.4 MATERIALS SOURCE SEPARATION

- .1 Before project start-up prepare Materials Source Separation Program (MSSP) and provide containers to deposit re-usable and/or recyclable materials of the following:
 - .1 Gypsum Board.
 - .2 Insulation.
 - .3 Acoustical ceiling panels.
 - .4 Metals.
 - .5 Wood.
 - .6 Cardboard.
 - .7 Plastics
 - .8 Other materials as indicated in technical sections.
- .2 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form:
 - .1 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled, and separated off-site or disposed of.
 - .2 For each material reused, sold, or recycled from project, include amount and the destination.
 - .3 For each material land filled or incinerated from project, include amount of material and identity of landfill, incinerator, or transfer station.
- .3 Implement Materials Source Separation Program (MSSP) for waste generated on project in compliance with methods as approved by Departmental Representative.
- .4 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .5 Locate separated materials in areas which minimize material damage.
- .6 Provide inventory of quantities of demolition materials to be salvaged for reuse, recycling, or disposal.

1.5 DIVERSION OF MATERIALS

- .1 Create a list of materials for separation from the general waste stream and stockpiled in separate containers, in compliance with fire regulations and to Departmental Representative's approval.
- .2 Mark containers and provide instruction on disposal practices.

1.6 STORAGE, HANDLING AND APPLICATION

- .1 Conform to Waste Reduction Work Plan.
- .2 Handle waste materials not being reused, salvaged or recycled in accordance with Authority Having Jurisdiction and fire regulations.
- .3 Collect, handle, store on site and transport off-site, all materials in separated condition, to an approved and authorized recycling facility.
- .4 Provide Departmental Representative with receipts indicating quantity of material delivered to landfill.
- .5 Except as specified otherwise, materials removed from the site become the contractor's responsibility.
- .6 On-site sale of salvaged/recycled material is not permitted.
- .7 Comply with site specific security requirements, per Section 01 14 10 Security Requirements.

1.7 HEALTH AND SAFETY

- .1 In accordance with Section 01 35 30 Health and Safety Requirements.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 RELATED SECTIONS

- .1 Section 01 78 00 – Closeout Submittals.
- .2 Division 22 – Plumbing.
- .3 Division 23 – Heating, Ventilating, and Air Conditioning.
- .4 Division 26 – Electrical.

1.3 INSPECTION AND DECLARATION

- .1 Project Phasing:
 - .1 The contractor shall submit a plan that inspects completed work at the completion of each phase, and corrects the work prior to proceeding to the next phase of the work.
 - .2 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Departmental Representative's Inspection.
 - .3 Departmental Representative's Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
 - .4 Substantial Completion: submit written certificate that the 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 Authority Having Jurisdiction.
 - .5 Commissioning of all systems: Final commissioning reports have been submitted to the Departmental Representative.
 - .6 Operation of systems has been demonstrated to Departmental

- Representative's personnel.
- .7 Work is complete and ready for Final Inspection.
 - .8 Close-out documents provided per Section 01 78 00 Closeout Submittals, and Section 23 06 02 Mechanical Forms.
- .5 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative. If Work is deemed incomplete by Department Representative, complete outstanding items, and request re-inspection.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 45 00 – Quality Control.
- .2 Section 01 77 00 – Closeout Procedures.
- .3 Section 23 06 02 – Mechanical Forms.
- .4 Section 26 05 00 – Common Work Results for Electrical.

1.2 SUBMISSION

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned after final inspection, with Departmental Representative's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two weeks prior to Interim Completion of the Work, submit to the Departmental Representative four final copies of operating and maintenance manuals in English.
- .5 Hard copies of the Operating and Maintenance Manual are required as specified under clause 1.3. Provide four copies.
- .6 Electronic PDF copy of the Operating and Maintenance Manual is required. Provide copy on CD or USB memory stick. Provide four copies.
- .7 Ensure spare parts, maintenance materials and special tools provided are new, un-damaged or defective, and of same quality and manufacture as products provided in Work.
- .8 If requested, furnish evidence as to type, source and quality of products provided.
- .9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .10 Pay costs of transportation.
- .11 Provide mechanical forms as listed in Section 23 06 02.
- .12 Provide electrical closeout documents as listed in Section 26 05 00.

1.3 FORMAT OF HARD COPY MANUALS

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD or USB memory stick.
- .10 Provide PDF copy of final O&M manuals on CD or USB memory stick for insertion into hard copy.

1.4 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 date of submission;
 - .2 names, addresses, and telephone numbers of Contractor, Subcontractors, Suppliers with name of responsible parties;
 - .3 schedule of products and systems, indexed to content of volume.
 - .4 copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.
 - .5 all extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification.
 - .6 complete set of all final reviewed shop drawings.
 - .7 certificates of inspection by Authority Having Jurisdiction.
 - .8 test reports and certificates as applicable.
 - .9 complete set of as-built drawings.
- .2 For each product or system:
 - .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Record of Training: Refer to Section 01 91 41 – Commissioning Training.

1.5 **'AS-BUILT' DRAWINGS AND SAMPLES**

- .1 In addition to requirements in General Conditions, maintain at the site one record copy of:
 - .1 Contract Drawings;
 - .2 Specifications;
 - .3 Addenda;
 - .4 Change Orders and other modifications to the Contract;
 - .5 Reviewed shop drawings, product data, and samples;
 - .6 Field test records;
 - .7 Inspection certificates;
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.
- .6 As part of project close-out, submit
 - .1 Four (4) sets of printed as-built drawings, and electronic copy on CD or USB memory stick. File formats shall be in AutoCAD (latest version) and PDF.
 - .2 Submit one copy of check plots to Departmental Representative prior to final printing of as-built drawings.
 - .3 Departmental Representative will supply copies of the original AutoCAD files.
 - .4 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.

- .5 Costs for transferring as-built information from marked up working set of drawings to electronic format using AutoCAD and plotting service is included in the Contract.

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings provided by Departmental Representative.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.7 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include all test and balancing reports.
- .15 Additional requirements: As specified in individual specification sections.

1.8 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

1.9 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Assemble parts as specified. Include part number, identification of equipment or system for which parts are applicable.
- .4 Deliver to location as directed; place and store.
- .5 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .6 Obtain receipt for delivered products and submit prior to final payment.

1.10 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.11 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.12 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .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 Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

END OF SECTION

Part 1

General

1.1

SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to Performance Verification of components, equipment, sub-systems, systems, and integrated systems.
- .2 Related Sections
 - .1 Section 01 33 00 – Submittal Procedures.
 - .2 Section 01 91 31 – Commissioning Plan.
 - .3 Section 01 91 33 – Commissioning Forms.
 - .4 Section 01 91 41 – Commissioning Training.
 - .5 Section 23 08 00 – Mechanical Commissioning.
 - .6 Section 23 08 01 – Performance Verification.
 - .7 Section 26 05 00 – Common Work Results for Electrical.
- .3 Acronyms:
 - .1 Cx - Commissioning
 - .2 CxA – Commissioning Authority (appointed by Departmental Representative)
 - .3 CxAg – Commissioning Agent (appointed by Mech. Contractor)
 - .4 CxMgr – Commissioning Manager (appointed by Prime Contractor)
 - .5 EMCS - Energy Monitoring and Control Systems.
 - .6 O M – Operating and Maintenance (staff)
 - .7 OMM - Operation and Maintenance Manuals
 - .8 PI - Product Information.
 - .9 PV - Performance Verification.
 - .10 TAB - Testing, Adjusting and Balancing.

1.2

REFERENCES

- .1 CSA Standard Z320 -2011 Building Commissioning
- .2 ASHRAE Standard 202-2018 -- Commissioning Process for Buildings and Systems

1.3 DEFINITIONS

- .1 Commissioning Authority (CxA) – an individual identified by the Departmental Representative to lead the commissioning team in the implementation of the commissioning process. If deemed necessary, this role may be appointed to an individual within the Departmental Representative’s organization, a third party company, or other specialist firm.
- .2 Prime Contractor’s Commissioning Manager (CxMgr) – an individual appointed by the prime contractor to manage the daily commissioning activities occurring within the general contract. Typically, this role is merged in with the Prime contractor’s site supervisor, with common activities delegated to the mechanical commissioning agent.
- .3 Contractor’s Commissioning Agent (CxAg) – a specialist retained by the mechanical contractor to execute mechanical commissioning activities. Respectively, an electrical commissioning agent may be retained depending on the electrical project requirements.
- .4 Commissioning Team – the group responsible for planning, implementing and executing the commissioning activities throughout the project phases. The commissioning team will typically include the Commissioning Authority, Commissioning Agents, Commissioning Manager, sub-contractors, equipment suppliers, O&M personnel, and Departmental Representative.

1.4 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor’s Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the OMM.
 - .3 Effectively train O M staff.
- .2 Contractor(s) assists in Cx process, operating equipment, and systems, troubleshooting, and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated interactively with each other as intended in accordance with Contract Documents and design criteria.

- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by the project drawings and specifications, to meet the Project functional and operational requirements.
- .4 Commissioning Manager and Commissioning Agent(s) shall coordinate their commissioning activities to avoid redundancy and inefficiencies.
- .5 Commissioning Manager (prime contractor) shall be the main point of contact for daily management of all commissioning activities, and shall be responsible for ensuring all activities and deliverables are collected and submitted to the Commissioning Authority as described herein.

1.5 COMMISSIONING OVERVIEW

- .1 In accordance with Section 01 91 31 Commissioning Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 Commissioning Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built systems are constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 Commissioning Authority will issue the recommended Interim Acceptance letter when:
 - .1 Completed Cx documentation has been received, reviewed for suitability.
 - .2 Equipment, components, and systems have been commissioned.
 - .3 O M training has been completed.

1.6 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by the Commissioning Authority, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by the

Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.7 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to the Commissioning Authority.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
 - .2 During Construction:
 - .1 Co-ordinate provision, location, and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, and systems are complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to the Commissioning Authority.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to Commissioning Authority for review and recommended approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Commissioning Authority in writing of discrepancies and deficiencies on finished works.

1.8 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Commissioning Authority before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.9 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
 - .1 Submit no later than 2 weeks after award of Contract:
 - .1 Name of Contractor's Cx Agent.
 - .2 Draft Commissioning Plan.
 - .3 Preliminary Commissioning schedule.
 - .2 Request in writing to Commissioning Authority for changes to submittals and obtain written approval at least [2] weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Commissioning Authority and obtain recommended approval at least 2 weeks prior to start of Cx.
 - .4 Provide supplemental support documentation relating to the Cx process as required by Commissioning Authority.

1.10 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 33 Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use. Contractor's Cx Agent shall submit their proposed Cx Forms for review by the Cx Authority, prior to implementation.
- .2 Commissioning Authority to review and recommend approval of Cx documentation.
- .3 Provide completed and reviewed Cx documentation to Commissioning Authority.

1.11 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Review and approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training (Systems demonstrations).

1.12 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings. Minimum of [5] Cx meetings: Kickoff (60%), 75% progress, 90% progress, 100% progress and final.

- .2 Purpose: to identify and resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, Cx Manager and/or Cx Agent to call a Cx kickoff meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meetings will be chaired by the Cx Manager and/or the Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at kickoff (60%) and subsequent Cx meetings and as required.

1.13 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing, and adjusting, including supply of testing equipment.

1.14 WITNESSING OF STARTING AND TESTING

- .1 Provide two weeks notice prior to commencement to allow adequate presence of relevant witnesses.
- .2 Commissioning Authority may need to witness start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers, and equipment manufacturers.

1.15 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for review and recommended approval by Commissioning Authority.
 - .3 Arrange for Commissioning Authority to witness tests.
 - .4 Obtain written review of test results and documentation from Commissioning Authority before delivery to site.

- .2 Obtain manufacturer's installation, start-up, and operations instructions prior to start-up of components, equipment and systems and submit for review to the Commissioning Authority
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.16 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain recommended approval from Commissioning Authority after distinct phases have been completed and before commencing next phase.
- .4 Document the required tests on approved PV forms.

- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Commissioning Authority. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures recommended by the Commissioning Authority.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures recommended by the Commissioning Authority.
 - .3 If evaluation report concludes that major damage has occurred, Commissioning Authority shall reject equipment use.
 - .1 Rejected equipment to be removed from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.17 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.18 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit to Commissioning Authority for review before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.19 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.20 START OF COMMISSIONING

- .1 Notify Commissioning Authority at least 2 weeks prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.21 INSTRUMENTS / EQUIPMENT

- .1 Submit to Cx Authority for review and recommended approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.22 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual and/or simulated operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.23 WITNESSING COMMISSIONING

- .1 Departmental Representative and/or Commissioning Authority to witness activities and verify results.

1.24 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of Authority Having Jurisdiction, arrange for AHJ

to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of Authority Having Jurisdiction. Provide copies to Commissioning Authority within one week of test and with Cx report.

1.25 COMMISSIONING CONSTRAINTS

- .1 Since access into secure or sensitive areas will be very difficult after occupancy, it is necessary to complete Cx of occupancy, weather, secure, and seasonal sensitive equipment, and systems before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.26 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when reviewed by Commissioning Authority in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.27 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 75% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of the Commissioning Authority.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to the Commissioning Authority.

1.28 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Commissioning Authority for third and subsequent verifications where:
 - .1 Verification of reported results that fail to receive the Cx Authority recommended approval.
 - .2 Repetition of second verification again fails to receive recommended approval.
 - .3 Commissioning Authority deems Contractor's request for second verification was premature.

1.29 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.30 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of the Commissioning Authority.
- .2 Report problems, faults or defects affecting Cx to the Commissioning Authority in writing. Stop Cx until problems are rectified. Proceed with recommended approval from the Commissioning Authority.

1.31 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and reviewed by the Commissioning Authority.

1.32 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.33 TRAINING / SYSTEMS DEMONSTRATION

- .1 In accordance with Section 01 91 41 Commissioning Training.

1.34 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.35 OCCUPANCY

- .1 Cooperate fully with Departmental Representative, and Commissioning Authority during stages of acceptance and occupancy of facility.

1.36 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with the Commissioning Authority.

- .2 Calibrated building control sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.37 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.38 PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Commissioning Authority will not relieve Contractor from compliance with specified start-up and testing procedures.

Part 2 Products

- .1 Commissioning documentation (plan, schedule, reports).

Part 3 Execution

- .1 Perform commissioning tasks during construction phase and warranty phase.

END OF SECTION

Part 1

General

1.1

SUMMARY

- .1 Section Includes:
 - .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.
- .2 Related Requirements
 - .1 Section 01 91 13 – Commissioning Requirements
 - .2 Section 01 91 33 – Commissioning Forms
 - .3 Section 01 91 41 – Commissioning Training
 - .4 Section 23 08 00 – Mechanical Commissioning
 - .5 Section 23 08 01 – Performance Verification
 - .6 Section 26 05 00 – Common Work Results for Electrical

1.2

REFERENCES

- .1 CSA Standard Z320-2011(R2016) Building Commissioning
- .2 ASHRAE Standard 202-2018 Commissioning Process for Buildings and Systems

1.3

GENERAL

- .1 Provide a fully functional mechanical and electrical system:
 - .1 Systems, equipment, and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
 - .2 Departmental Representative and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

- .3 Sets out deliverables relating to O&M, process, and administration of Cx.
- .4 Describes process of verification of how built works meets the project requirements.
- .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
- .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 Cx - Commissioning
 - .2 CxA – Commissioning Authority
 - .3 CxAg – Commissioning Agent (Contractor)
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O M – Operating and Maintenance (staff)
 - .6 OMM - Operation and Maintenance Manuals
 - .7 PI - Product Information.
 - .8 PV - Performance Verification.
 - .9 TAB - Testing, Adjusting and Balancing.
 - .10 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 95% completed before the start of commissioning in the construction phase.
- .2 Cx Plan to be 100% completed 2 weeks prior to the start of commissioning activities, take into account:
 - .1 Approved shop drawings and product data.

- .2 Approved changes to contract.
- .3 Contractor's project schedule.
- .4 Cx schedule.
- .5 Requirements of Contractor, sub-contractor, suppliers.
- .6 Project construction team's and Cx team's requirements.
- .3 Submit completed Cx Plan to Commissioning Authority, obtain written review and recommended approval.

1.5 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan (as needed) to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
- .2 Revise, refine and update as needed during the construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to Commissioning Authority for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.6 COMPOSITION, ROLES, AND RESPONSIBILITIES OF CX TEAM

- .1 Departmental Representative to maintain overall responsibility for the project, and communicates directly with the Commissioning Authority and Commissioning Manager.
- .2 Commissioning Authority shall report to the Departmental Representative and reviews all commissioning activities and deliverables prior to project handover.
- .3 Commissioning Manager (prime contractor) is main point of contact between members of commissioning team, and manages the daily commissioning activities that may occur. Cx Manager shall collect Cx documentation from Cx Agents, and submit to the Commissioning Authority for review.
- .4 Commissioning Agent (mechanical) executes the mechanical specific Cx activities. Electrical trade may retain an electrical Cx Agent as needed. Cx Agent reports to the Cx Manager, and/or may report directly to the Cx Authority.
- .5 Project Manager will select Cx Team consisting of following members:
 - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

- .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Cx documentation from operational perspective.
 - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .3 Protection of health, safety and comfort of occupants and O M personnel.
 - .4 Monitoring of Cx activities, training, development of Cx documentation.
 - .5 Work closely with members of Cx Team.
- .3 Commissioning Authority is responsible for:
 - .1 Overseeing and reviewing Cx.
 - .2 Monitoring Cx activities.
 - .3 Witnessing, verifying accuracy of reported results.
 - .4 Witnessing and verifying TAB and other tests.
 - .5 Reviewing OMM
 - .6 Reviewing and ensuring implementation of final Cx Plan.
 - .7 Reviewing performance verification results of installed systems and equipment
 - .8 Reviewing implementation of Training Plan.
- .4 Construction Team: prime contractor, contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning Commissioning Manager as point of contact with Commissioning Authority, Departmental Representative, and PWGSC Cx Manager for administrative and coordination purposes.

- .5 Contractor's Cx agent executes specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training.
 - .3 Testing.
 - .4 Preparation, submission of test reports.
- .6 Departmental Representative and/or O&M Manager: represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
 - .5 Client: responsible for intrusion and access security systems.
 - .6 Ensure that Cx participant:
 - .1 Could complete work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O M personnel.

- .4 Redistribution of electrical services.
- .5 Modifications to voice communications systems.
- .7 Provide names of participants to the Commissioning Authority and details of instruments and procedures to be followed for Cx 2 weeks prior to starting date of Cx for review and recommended approval.

1.8 RISK ASSESSMENT

- .1 Not used.

1.9 EXTENT OF CX

- .1 Cx Structural and Architectural Systems:
 - .1 Not applicable.
- .2 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Condensate Drainage and Condensate Pumps
 - .2 HVAC systems:
 - .1 Air Handling Units
 - .2 Heat Recovery Ventilators
 - .3 Fans
 - .4 Split Air Conditioning Systems
 - .5 HVAC Controls and Graphics
 - .3 Noise and vibration control systems for mechanical systems.
 - .1 Air Handling Units
 - .2 Heat Recovery Ventilators
 - .3 Fans
 - .4 Split Air Conditioning Systems
 - .5 Condensate pumps
 - .4 Seismic restraint and control measures.
 - .1 Rooftop mounted equipment
 - .2 Ceiling and wall mounted mechanical equipment
- .3 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.

1.10 DELIVERABLES RELATING TO O M PERSPECTIVES

- .1 General requirements:
 - .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools, and maintenance materials.
 - .4 WHMIS information.
 - .5 MSDS data sheets.
 - .6 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.11 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
 - .1 Cx as used in this section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
 - .1 Start-up, pre-Cx activities and documentation for systems, and equipment.
 - .2 Completed installation checklists.
 - .3 Completed product information (PI) report forms.
 - .4 Completed performance verification (PV) report forms.
 - .5 Results of Performance Verification Tests and Inspections.
 - .6 Description of Cx activities and documentation.
 - .7 Description of Cx of integrated systems and documentation.
 - .8 Tests witnessed by Commissioning Authority and/or PWGSC Design

Quality Review Team:

- .9 Tests performed.
- .10 Training (Systems Demonstrations) Plans.
- .11 Cx Reports.
- .12 Prescribed activities during warranty period.
- .4 Contractor's Commissioning Agent to witness and review tests and reports of results prior to providing to Cx Mgr and Cx Authority.

1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by Cx Agent prior to permission to start-up and rectification of deficiencies to Commissioning Authority's satisfaction.
 - .2 Cx Agent to use approved check lists.
 - .3 Cx Agent will monitor and/or perform all these pre-start-up inspections.
 - .4 Include completed documentation with Cx report.
 - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed by Cx Authority and does not form part of Cx specifications.
 - .6 Departmental Representative will monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL AND STRUCTURAL:
 - .1 Not applicable.
- .3 Pre-Cx activities - MECHANICAL:
 - .1 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 At this time, complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be reviewed by the contractor's Cx Agent prior to submitting to the Cx Manager

and Cx Authority.

- .2 EMCS:
 - .1 EMCS trending to be available as supporting documentation for performance verification.
 - .2 Perform point-by-point testing in parallel with start-up.
 - .3 Carry out point-by-point verification.
 - .4 Demonstrate performance of systems, to be witnessed by the Commissioning Authority prior to start of [30] day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and 30-day test period.
 - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .4 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre-energization and post-energization tests.

1.13 **START-UP**

- .1 Start up components, equipment, and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
 - .1 Air Handling Units
 - .2 Fans
 - .3 Pumps
- .3 Commissioning Agent to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Commissioning Authority.
- .4 Performance Verification (PV):
 - .1 Contractor's Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Commissioning Authority.
 - .2 Contractor's Cx Agent to use procedures modified from generic procedures to suit project requirements.
 - .3 Contractor's Cx Agent to witness and review reported results using

approved PI and PV forms.

- .4 Contractor's Cx Agent to review completed PV reports and provide to Cx Mgr and Cx Authority.
- .5 Commissioning Authority reserves right to verify up to 50% of reported results at random.
- .6 Failure of randomly selected item shall result in rejection of PV report or report of system start up and testing.

1.14 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by the Commissioning Authority or alternate procedures proposed by the Contractor's commissioning agent and reviewed by the Cx Authority prior to commencement.
- .2 Commissioning Manager to monitor daily Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Contractor's Commissioning Agent to witness, review reported results of, Cx activities and forward to Cx Manager and Cx Authority for recommended approval.
- .5 Commissioning Authority reserves the right to verify up to 50% percent of reported results at no cost to contract.

1.15 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by the Commissioning Authority and/or alternate procedures proposed by the Contractor's commissioning agent and reviewed by the Cx Authority prior to commencement.
- .2 Tests to be witnessed by the Cx Authority and documented on approved report forms by the Cx Agent.
- .3 Upon satisfactory completion, Cx agent to prepare Cx Report, to be reviewed by the Commissioning Authority for recommended approval.
- .4 Commissioning Authority reserves the right to verify up to 50% percent of reported results at no cost to contract.
- .5 Integrated systems to include:
 - .1 Air Handling Units controls and monitoring
 - .2 Fan controls and monitoring
- .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance Contractor's commissioning agent to co-operate to complete inventory data sheets and provide assistance to PWGSC in full

implementation of MMS identification system of components, equipment, sub-systems, and main systems.

1.16 INSTALLATION CHECK LISTS (ICL)

- .1 In accordance with Section 01 91 33 Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 In accordance with Section 01 91 33 Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.18 PERFORMANCE VERIFICATION (PV) REPORT

- .1 In accordance with Section 01 91 33 Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.19 DELIVERABLES RELATING TO ADMINISTRATION OF CX

- .1 General:
 - .1 Because of risk assessment, complete Cx of occupancy, weather, security, and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.20 CX SCHEDULES

- .1 Cx Manager and Cx agent to prepare detailed Cx Schedule and submit to Commissioning Authority for review at the same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems, and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Pre-TAB review: within 4 weeks after award of contract, before construction starts.
 - .3 Cx agents' credentials: within 4 weeks after award of contract.
 - .4 Cx procedures: within 4 weeks after award of contract.
 - .5 Cx Report format: within 4 weeks after award of contract.
 - .6 Discussion of heating/cooling loads for Cx: within 4 weeks after award of contract.
 - .7 Submission of list of instrumentation with relevant certificates: 3 weeks before start of Cx.

- .8 Notification of intention to start TAB: 4 weeks before start of TAB.
- .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
- .10 Notification of intention to start Cx: 2 weeks before start of Cx.
- .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 1 week before start of integrated system Cx.
- .12 Identification of deferred Cx.
- .13 Implementation of training plans.
- .14 Cx of control systems: after Cx of related systems is completed and 2 weeks before proposed date of Cx these systems.
- .15 Cx reports: within 1 week upon successful completion of Cx.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Departmental Representative.
- .3 Within 10 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 Upon review of Cx activities, incorporate Cx Schedule into Construction Schedule.
- .3 Prime Contractor, Contractor's Cx agent, and Commissioning Authority will monitor progress of Cx against this schedule.

1.21 CX REPORTS

- .1 Cx Manager shall submit reports of tests, reported by the Cx Agent, to the Cx Authority who will review and verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by the Commissioning Authority.

1.22 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems.
 - .2 Deferred seasonal testing.
 - .3 Deferred testing due to security and access restrictions.

1.23 TESTS TO BE PERFORMED BY USER

- .1 None is anticipated on this project.

1.24 TRAINING PLANS

- .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

1.25 FINAL SETTINGS

- .1 Upon completion of Cx to satisfaction of Commissioning Authority lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

Part 2 Products

2.1 DOCUMENTATION

- .1 Commissioning documentation (draft commissioning plan, updated commissioning plan).

Part 3 Execution

3.1 SCHEDULE

- .1 Submit commissioning plan during construction phase, and update accordingly.

END OF SECTION

Part 1

General

1.1

SUMMARY

- .1 Section Includes:
 - .1 Commissioning forms to be completed for equipment, system, and integrated system.
- .2 Related Requirements
 - .1 Section 01 91 13 Commissioning Requirements
 - .2 Section 01 91 31 Commissioning Plan
 - .3 Section 01 91 41 Commissioning Training
 - .4 Section 23 08 00 Mechanical Commissioning
 - .5 Section 26 05 00 Common Work Results for Electrical

1.2

INSTALLATION/START-UP CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Commissioning Authority supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Commissioning Authority. Check lists will be required during Commissioning and will be included in the Operations & Maintenance Manual (OMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3

PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and

maintenance of equipment. This documentation is included in the OMM at completion of work.

- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Commissioning Authority recommended approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Commissioning Agent shall submit proposed PV forms to Cx Authority for review prior to implementation.
- .2 Revise items on Commissioning forms to suit project requirements.

1.6 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .2 Confirm operation as per design criteria and intent.
 - .3 Identify variances between design and operation and reasons for variances.
 - .4 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .5 Record analytical and substantiating data.
 - .6 Verify reported results.
 - .7 Form to bear signatures of recording technician and reviewed and signed off by Cx Agent.
 - .8 Submit immediately after tests are performed.

- .9 Reported results in true measured SI unit values.
- .10 Provide Commissioning Authority with originals of completed forms.
- .11 Maintain copy on site during start-up, testing and commissioning period.
- .12 Forms to be both hard copy and electronic format with typed written results for insertion into the OMM (Operations & Maintenance Manuals).

1.7 LANGUAGE

- .1 English.

Part 2 Products

2.1 DOCUMENTATION

- .1 Commissioning documentation (checklists, sign-off forms)

Part 3 Execution

3.1 SCHEDULE

- .1 Perform commissioning tasks during construction phase and warranty phase.

END OF SECTION

Part 1

General

1.1

SUMMARY

- .1 Section Includes:
 - .1 This Section specifies roles and responsibilities of Commissioning Training.
- .2 Related Requirements
 - .1 Section 01 91 13 – Commissioning Requirements
 - .2 Section 01 91 31 – Commissioning Plan
 - .3 Section 01 91 33 – Commissioning Forms
 - .4 Section 23 08 00 – Mechanical Commissioning
 - .5 Section 26 05 00 – Common Work Results for Electrical

1.2

TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3

INSTRUCTORS

- .1 Cx Manager and/or Cx Agent will provide:
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components, and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment, and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4

TRAINING OBJECTIVES

- .1 Training to be detailed and concise in duration to ensure:

- .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and troubleshooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Provide training agenda and schedule.
- .3 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Operating & Maintenance Manual.
 - .4 TAB and PV Reports.
- .4 Departmental Representative and/or Cx Authority will review training materials.
- .5 Training materials to be in a format that permits future training procedures of same degree of detail to be added.
- .6 Training session shall include a group walkthrough of the renovation area.
- .7 Supplement training materials:
 - .1 Multimedia presentations (PowerPoint, PDF)
 - .2 Manufacturer's training videos.

1.6 SCHEDULING

- .1 Commissioning Schedule shall include training time.
- .2 Deliver training during regular working hours, training sessions to be [4] hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,

- .3 Quality of training and development of training materials,
- .2 Departmental Representative and/or Commissioning Authority will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative, and/or Commissioning Authority.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components, and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance, and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.
 - .9 Interaction among systems during integrated operation.
 - .10 Review of O M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

Part 2 Products

2.1 DOCUMENTATION

- .1 Training materials and documentation (as applicable).

Part 3 Execution

3.1 SCHEDULING AND AGENDA

- .1 Provide training agenda listing all included systems, and indicate time allocations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Removal and or salvage of designated construction.
- .2 Disposal of materials.

1.2 RELATED SECTIONS

- .1 Section 01 01 50 – General Instructions (CSC)
- .2 Section 01 74 19 – Waste Management and Disposal
- .3 Section 01 35 30 – Health and Safety Requirements
- .4 Section 02 81 01 – Hazardous Materials
- .5 Appendix-A – Hazardous Building Materials Assessment

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code Part 8

1.4 GENERAL

- .1 Submit detailed schedule for any and all work affecting the existing building. Consult with CSC regarding work required. Submit schedule minimum 10 calendar days prior to scheduled work.
- .2 Comply with requirement of the Waste Management and Disposal Requirements in Section 01 74 19 – Waste Management and Disposal.
- .3 Comply with requirement of the Hazardous Materials testing and removal requirements in Section 02 81 01 – Hazardous Materials.
- .4 Provide a destructive, pre-construction hazardous building material assessment upon removal of existing roof top units. The report with results must be provided to the Department Representative prior to the addition of the new roof top units. If any hazardous material of concern are identified (i.e. asbestos, lead, PCB, mercury, silica), stop work and consult with Department Representative. Identified hazardous material must be addressed before any work can continue.

1.5 SCHEDULING

- .1 Submit with the project schedule a coordinated complete series of drawings, diagrams, details and supporting data clearly showing sequence of demolition and removal work, reconstruction, occupant moves required, material storage, temporary barriers for all phases of the demolition construction work.

- .2 Perform noisy, malodorous, dusty, work as directed by CSC and the Departmental Representative.

1.6 SITE CONDITIONS

- .1 Review the Project Specific Hazardous Building Materials Assessment for the Chilliwack Correctional Centre with the Departmental Representative.
 - .1 Remove hazardous materials in a manner consistent with the Occupational Health & Safety Regulation, General Hazard Requirements of the Work Safe BC, and other applicable regulations. Changes to the Work will be dealt in accordance with the provisions of the Contract Documents.
 - .2 Handle and dispose of all hazardous and banned materials in accordance with the Special Waste Regulation, and Regional and Municipal regulations. These hazardous and banned materials include but are not limited to asbestos, drywall (banned from disposal), Polychlorinated Biphenyls (PCBs), abandoned chemicals (gasoline, pesticides, herbicides, flammable and combustible substances), all refrigerant from cooling equipment, lead-based paints, smoke detectors, and mercury containing switches.
- .2 Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
 - .1 Do not proceed until written instructions have been received from the Departmental Representative.
- .3 Notify Departmental Representative minimum 5 working days before disrupting building access or services.
- .4 The Contractor shall accept the site as it exists and will be responsible for all deconstruction work as required.

1.7 DEMOLITION PROCEDURES

- .1 Materials: As specified in Product sections; match existing Products and work for patching and extending work.
- .2 Employ skilled and experienced installer to perform alteration work.
- .3 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- .4 Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to original condition.
- .5 Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with a neat transition to adjacent finishes.

- .6 Where new Work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .7 When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Departmental Representative for review.
- .8 Where a change of plane of 6 mm or more occurs, submit recommendation for providing a smooth transition; to Departmental Representative for review. Request instructions from the Departmental Representative.
- .9 Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .10 Finish surfaces as specified in individual Product sections.

1.8 PROTECTION

- .1 Prevent movement, settlement, or other damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
- .2 Keep noise, dust, and inconvenience to occupants to a minimum. Noisy work will only be permitted at times agreed to and accepted by the Departmental Representative.
- .3 Protect building mechanical and electrical systems, services, and equipment.
- .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
- .5 Do not overload any portion of the structure with material or equipment
- .6 Where existing load bearing partitions are to be removed, do not commence work until new support structure is installed, inspected, and approved by the Departmental Representative.
- .7 Cease operations and notify the Departmental Representative if safety of any adjacent work or structure appears to be endangered. Take all precautions to support the structure. Do not resume operations until reviewed with the Departmental Representative.
- .8 Ensure safe passage of building occupants around area of demolition. Remove debris and clean areas of access immediately.
- .9 Conduct demolition to minimize interference with adjacent and occupied building areas.

1.9 QUALITY ASSURANCE

- .1 Salvage or Demolition Firm: Company (ies) must be experienced and specializing in performing the work of this section with documented experience in similar types of deconstruction work.
- .2 Qualifications of Workers: Provide a supervisor who shall be present at all times during the deconstruction work and who shall be thoroughly familiar with the work required and who shall direct all work. Provide one person on site who is responsible for maintaining the safety barriers and protection of the workers and the public.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 Inspect building & site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Provide, erect, and maintain temporary barriers security partitions at locations indicated agreed to with CSC and the Departmental Representative.
 - .1 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued occupancy. Refer to complete project drawings. The extent of the partitions required may exceed the information shown on the demolition drawings.
- .3 Erect and maintain weatherproof closures for exterior openings.
- .4 Protect existing materials which are not to be demolished.
- .5 Prevent movement of structure; provide bracing and shoring.

3.2 PROTECTION

- .1 Maintain public safety and traffic control precautions at all times during the demolition work, using properly trained qualified persons to control all Contractor's activities, vehicles, equipment, traffic and all public pedestrian and vehicles traffic that are coming to and from the site or passing along the vicinity of the site access locations.
- .2 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
- .3 Keep noise, dust, and inconvenience to occupants to minimum.
- .4 Protect building systems, services, and equipment.
- .5 Do Work in accordance with Section 01 35 30 – Health and Safety

Requirements.

3.3 SITE REMOVALS

- .1 Remove items as indicated.

3.4 DEMOLITION

- .1 The electrical, BSCS, or mechanical services **MUST NOT** be terminated within the building at any time. Notify the building Departmental Representative of any requirements for partial termination of services in accordance with Division 1 requirements. Keep down time at a minimum.
- .2 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for reuse, recycling, or disposal.
 - .1 Demolish in an orderly and careful manner. Protect existing supporting structural members.
 - .2 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
 - .3 Remove temporary Work.

3.5 DISPOSAL

- .1 Dispose of removed materials, to appropriate recycling facilities except where specified otherwise, in accordance with Authority Having Jurisdiction.

END OF SECTION

Part 1

General

1.1

RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 35 33 – Health and Safety Requirements
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 01 74 11 – Cleaning and Special Cleaning Procedures
- .5 Appendix – Hazardous Buildings Material Assessment

1.2

REFERENCES

- .1 Refer to the following report (further referred to herein as the “Assessment Report”), attached in Appendix A of the Project Specifications, for information pertaining to hazardous building materials that have been identified and must be removed and disposed of to complete the Work:
 - .1 “Hazardous Building Materials Assessment; Six Buildings/Structures at CSC Chilliwack Community Correctional Centre, 45914 Rowat Avenue, Chilliwack, BC”, prepared by Stantec Consulting Ltd., dated March 21, 2018

1.3

DEFINITIONS

- .1 Dangerous Goods: product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .2 Hazardous Building Material: component of a building or structure that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when altered, disturbed or removed during maintenance, renovation or demolition.
- .3 Hazardous Material: product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .4 Hazardous Waste: any hazardous material that is no longer used for its original purpose and that is intended for recycling, treatment or disposal.

1.4

REFERENCE STANDARDS

- .1 Canadian Environmental Protection Act, 1999 (CEPA 1999).
 - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada Institute for Research in Construction (NRC-IRC)
 - .1 National Fire Code of Canada 2015.
- .4 Department of Justice Canada
 - .1 Transportation of Dangerous Goods Act (TDG Act) 1999, (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2003-400).
- .5 Government of Canada
 - .1 The Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations (COHSR)
 - .2 The Federal PCB Regulations (SOR/2008-273).
 - .3 The Federal Halocarbons Regulation (July 2003).
- .6 Public Services and Procurement Canada
 - .1 Asbestos Management Directive (June 5, 2017)
 - .2 Asbestos Management Standard (June 5, 2017)
- .7 WorkSafe BC
 - .1 British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97), including amendments to date of work)
 - .2 "Safe Work Practices for Handling Asbestos" (2017)
 - .3 "Lead-Containing Paints and Coatings; Preventing Exposure in the Construction Industry" (2011)
 - .4 "Safe Work Practices for Handling Lead" (2017)
- .8 Government of British Columbia
 - .1 British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
- .9 Canadian Construction Association
 - .1 Standard Construction Document CCA 82 "Mould Guidelines for the Canadian Construction Industry" (2004 – further referred to herein as "CCA 82").

1.5 SUBMITTALS

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

- .2 Product Data for hazardous materials to be used by the Contractor to complete the Work:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
 - .3 Submit hazardous materials management plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.
 - .4 Construction/Demolition Waste Management:
 - .1 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating percentage of construction/demolition wastes were recycled or salvaged
 - .5 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle hazardous materials to be used by the Contractor to complete the Work in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver hazardous materials to be used by the Contractor to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Co-ordinate storage of hazardous materials to be used by the Contractor to complete the Work with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.
 - .2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
 - .3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
 - .4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

- .1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.
- .2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.
- .5 Transfer of flammable and combustible liquids is prohibited within buildings.
- .6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.
- .7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.
- .8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:
 - .1 Store hazardous materials and wastes in closed and sealed containers.
 - .2 Label containers of hazardous materials and wastes in accordance with WHMIS.
 - .3 Store hazardous materials and wastes in containers compatible with that material or waste.
 - .4 Segregate incompatible materials and wastes.
 - .5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.
 - .6 Store hazardous materials and wastes in secure storage area with controlled access.
 - .7 Maintain clear egress from storage area.
 - .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
 - .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
 - .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
- .11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

- .12 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.
- .4 Include provisions for Work of this Section in Waste Reduction Workplan as outlined in Section 01 74 19 – Waste Management and Disposal.

1.7 TRANSPORTATION

- .1 Transport hazardous materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
- .2 If hazardous waste is generated on site:
 - .1 Co-ordinate transportation and disposal with Departmental Representative.
 - .2 Ensure compliance with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.
 - .3 Use licensed carrier authorized by provincial authorities to accept subject material.
 - .4 Prior to shipping material obtain written notice from intended hazardous waste treatment or disposal facility that it will accept material and that it is licensed to accept this material.
 - .5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.
 - .6 Ensure that trained personnel handle, offer for transport, or transport dangerous goods.
 - .7 Provide photocopy of shipping documents and waste manifests to Departmental Representative.
 - .8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide a photocopy of completed manifest to Departmental Representative.
 - .9 Report discharge, emission, or escape of hazardous materials immediately to Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

1.8 EXISTING CONDITIONS

- .1 Reports and information pertaining to hazardous building materials present within the building that may be handled, removed, or otherwise disturbed and disposed of during this Project are included in the Appendix A of the Project Specifications.
- .2 Notify Departmental Representative of suspected hazardous building material discovered during Work and not apparent from drawings, specifications, or reports pertaining to the Work. Do not disturb such

material until such time as instructions are received from Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Only bring on site quantity of hazardous materials required to perform work.
- .2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 Execution

3.1 HAZARDOUS BUILDING MATERIALS ABATEMENT

- .1 Abatement shall be conducted to handle, alter, remove and dispose of hazardous building materials as identified in the Assessment Report in accordance with applicable regulations, guidelines, standards and/or best practices for such work, only to the extent that such identified hazardous building materials will be impacted (handled, altered, damaged, removed) by the Work.
- .2 Contractor is responsible for reviewing plans, specifications and reports such that they understand the locations and amounts of hazardous materials that will be impacted by the Work of this contract, and such that appropriate plans and budgets can be included in their overall bids.
- .3 Where there is a discrepancy between the information in this specification as compared to the information in the Assessment Report as it pertains to identities, locations and/or quantities of identified hazardous building materials, the information in the Assessment Report will prevail.
 - .1 If discrepancies are present pertaining to identities, locations and/or quantities of identified hazardous building materials, it is the Contractor's responsibility to request information to clarify such discrepancies during the bidding period. No additional costs will be allowed by the Contractor for additional labour or materials required to complete required abatement related to such discrepancies.
- .4 The listing below is a summary of the identified hazardous building material categories that may require disturbance, along with the associated removal and disposal regulations, guidelines and/or standards.
 - .1 Asbestos-Containing Materials (ACMs)

- .1 Refer to the Assessment Report for identities and locations of ACMs. Although the Contractor is responsible to review this information in light of their proposed methods for completing the Work, a preliminary review indicates that although various ACMs were identified, only the following ACMs will require consideration:
 - .1 White/grey roof sealant applied to seams of make-up air unit
- .2 Contractor is responsible to conduct additional assessment and testing, as may be required, to determine the asbestos content of roofing materials and/or layers other than those assessed and/or sampled as part of the Assessment Report.
 - .1 Assessment and/or sampling must be completed by appropriately qualified persons, in accordance with the protocols outlined in the WorksafeBC 2017 publication "Safe Work Practices for Handling Asbestos".
 - .2 The number of samples collected to characterize a particular roofing material or layer must meet the minimum requirements outlined in the WorksafeBC 2017 publication "Safe Work Practices for Handling Asbestos".
 - .3 Samples collected must be submitted to an appropriately accredited laboratory for analysis. Preferred accreditation is National Voluntary Laboratory Accreditation Program (NVLAP).
 - .4 If additional ACMs are identified through this process, and additional identified ACMs will require disturbance during the Work, costs associated with additional required abatement provisions (if any) must be submitted through the project change request process. Abatement (disturbance, removal, etc.) of additional identified ACMs shall not be undertaken until additional costs are formally approved.
- .3 Actions that will disturb identified ACMs are to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication "Safe Work Practices for Handling Asbestos", by appropriately trained personnel.
 - .1 Submit Provincial and/or local requirements for Notice of Project Form.
 - .2 Submit proof of Contractor's Asbestos Liability Insurance.
 - .3 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos

- containing waste and proof that asbestos containing waste has been received and properly disposed.
- .4 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Instruction and training related to respirators is to include, at a minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
 - .5 Contractor is to conduct a risk assessment and document work procedures for actions/tasks that will or may disturb identified ACMs.
 - .6 Contractor is to submit the documented work procedures to the Departmental Representative for review, at least 10 days prior to initiation of work.
 - .1 Documented work procedures must either:
 - .1 Include provisions for air monitoring; or,
 - .2 Include risk assessments/work procedures with sufficient details to describe why air monitoring is not required.
 - .7 Contractor must not proceed with work that will impact identified ACMs without approval from Departmental Representative.
 - .8 If, in the opinion of the Departmental Representative, the work procedures developed by the Contractor do not meet the intent of the 2017 WorkSafeBC publication "Safe Work Practices for Handling Asbestos", revisions will be required, at no cost to the Departmental Representative, and at no impact to the schedule.
 - .9 If air monitoring is required as part of the Contractor's work procedures, Contractor shall retain an independent, qualified third party to take air samples inside and outside of Asbestos Work Areas in accordance with the most stringent of the recommendations set forth in the Canada Labour Code Part II, Occupational Health and Safety Regulations, BC Reg. 296/97 and the 2017

- WorkSafeBC Manual "Safe Work Practices for Handling Asbestos".
- .1 Air samples will be collected and analyzed in accordance with NIOSH method 7400.
 - .2 Air sample results will be provided to the Contractor and Departmental Representative within 24-hours of sample collection.
 - .3 Analysis will be conducted by qualified persons or laboratories that take part in a documented QA/QC program for such analysis.
 - .11 Contractor to stop Work when airborne fibre measurements exceed 0.05 fiber/cubic centimetre (f/cc), when PPE and protection factors are considered, and to correct procedures.
 - .12 Additional monitoring will be conducted, where possible, to verify procedural corrections were effective.
 - .13 If air monitoring shows that areas outside Asbestos Work Area are contaminated as determined by the Departmental Representative, Contractor will be notified to maintain and clean these areas in same manner as that applicable to Asbestos Work Area, at no additional cost to the Contract.
 - .14 When asbestos leakage from Asbestos Work Area has occurred, or is likely to occur, Departmental Representative may order Work shutdown and correction of deficiencies.
 - .15 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level
 - .4 Asbestos waste transportation and disposal to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
 - .2 Lead and Lead-Containing Paints (LCPs)
 - .1 Refer to the Assessment Report for identities and locations of actual or potential lead-containing materials (including potential lead-containing paints).
 - .2 Actions that will disturb lead-containing materials (including paints and materials coated with paints) are to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication "Safe Work Practices for Handling Lead", keeping airborne exposure to lead dust to less than COHSR and BC Reg. 296/97 regulated 8-hour Occupational Exposure Limit (OEL) for lead of 0.05 milligram per cubic metre (mg/m³).

- .1 Actual methods to maintain exposures within applicable limits are to be determined by the contractor through their own risk assessment, which will take into account the lead content of the materials or paints as indicated in the Assessment Report, along with their planned disturbance methods (and associated dust control), tools, PPE and the overall duration of the work.
 - .1 Although formal evaluation is ultimately the responsibility of the Contractor, limited hazards are expected associated with the lead content of paints and other items to be disturbed, based on the information in the Assessment Report.
- .3 Although paints and items coated with paints may be disturbed and/or removed for disposal during the Work, unless deemed necessary through risk assessment or cost analysis conducted by the Contractor, comprehensive removal of paints from items or surfaces is not expected to be required during the Work.
- .4 Refer to the provisions of the 2017 WorkSafeBC document "Safe Work Practices for Handling Lead" for removal of LCPs from surfaces before any welding and torch-cutting, should the Contractor plan to use such methods to complete the Work.
 - .1 Contractor will be responsible for verification testing of surfaces where LCPs have been removed. Confirmation of acceptable results is to be provided to the Departmental Representative for review before proceeding with any welding or torch-cutting on surfaces where LCPs were present.
- .5 Waste transportation and disposal to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
- .3 Polychlorinated Biphenyls (PCBs)
 - .1 As per the Assessment Report, PCB-containing items are not anticipated to be present.
- .4 Mould
 - .1 Removal, alteration and/or disposal of mould-impacted materials is not anticipated to be required during the Work.
- .5 Mercury
 - .1 Removal, alteration and/or disposal of mercury-containing items or equipment is not anticipated to be required during the Work.
- .6 Ozone-Depleting Substances (ODSs)

- .1 If ODS-containing equipment (and non-ODS-containing equipment containing hydrofluorocarbons [HFCs]) is to be removed, refrigerants must be recovered, handled, recycled, stored, and/or disposed of in accordance with the requirements of the following:
 - .1 British Columbia Environmental Management Act—Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 387/99 as amended by BC Reg. 317/2012).
 - .2 The transportation requirements of the Federal Transportation of Dangerous Goods Act and Regulations.
 - .3 The Federal Halocarbons Regulations.

.7 Silica

- .1 When silica-containing materials are to be disturbed and/or removed (e.g., coring through concrete), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed 50% of the exposure limit as stipulated by BC Reg. 296/97. This would include, but not be limited to, the following:
 - .1 Development of an exposure control plan
 - .2 Providing workers with respiratory protection
 - .3 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
 - .4 Providing workers with facilities to properly wash prior to exiting the work area.

3.2 DISPOSAL

- .1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.
- .3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
- .6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

- .7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.
- .8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:
 - .1 Hazardous wastes recycled in manner constituting disposal.
 - .2 Hazardous waste burned for energy recovery.
 - .3 Lead-acid battery recycling.
 - .4 Hazardous wastes with economically recoverable precious metals.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 Cleaning and Special Cleaning Procedures. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 Cleaning and Special Cleaning Procedures.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 52 00 - Modified Bituminous Membrane Roofing

1.2 REFERENCES

- .1 CSA International
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O121-17, Douglas Fir Plywood.
 - .3 CAN/CSA-O141- 05 (R2019), Softwood Lumber.
 - .4 CSA O151-17, Canadian Softwood Plywood.
 - .5 CAN/CSA-O325- 16, Construction Sheathing.
 - .6 CAN/CSA O80-15 series, Wood Preservation.
 - .7 CAN/CSA O86-19, Engineering Design in Wood.
- .2 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001- 2004, FSC Principle and Criteria for Forest Stewardship.
 - .2 FSC-STD-20-002- 2004, Structure and Content of Forest Stewardship Standards V2-1.
 - .3 FSC Accredited Certified Bodies.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-11- 2015, 3rd Edition, Paints and Coatings.
- .4 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2017.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113- A2016, Architectural Coatings.

1.3 ACTION & INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for rough carpentry work and include product characteristics, performance criteria, physical size, finish and limitations.

- .3 Wood Certification: submit vendor's Chain-of-Custody Certificate number for FSC certified wood.
- .4 Low-Emitting Materials:
 - .1 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins, and laminate adhesives used in building, stating that they contain no urea-formaldehyde.

1.4 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.
- .3 Sustainable Standards Certification:
 - .1 Certified Wood: submit listing of wood products and materials used in accordance with FSC-STD-01-001.

1.5 DELIVERY, STORAGE & HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 Waste Management and Disposal.
 - .5 Packaging Waste Management: remove for reuse and return by manufacturer of and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less, SPF No.1 grade or better in accordance with following standards:
 - .1 CAN/CSA-O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
 - .3 FSC certified.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing:
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.
 - .3 Post and timbers sizes: "Standard" or better grade.
- .3 Pressure treatment of wood materials:
 - .1 All timber members shall be treated with water-borne salts:
 - .1 Conform to CSA O80 Series and its current amendments.
 - .2 Only Alkaline Copper Quat (ACQ-C, ACQ-D, ACQ-D Carbonate) and Copper Azole (CBA-A & CA-B) will be accepted.
 - .3 Retention: 6.4 kg/m³ (0.4 lb/ft³) for ACQ; 6.58 kg/m³ (0.41 lb/ft³) for CBA-A and 3.37 kg/m³ (0.21 lb/ft³) for CA-B.
 - .4 Minimum depth of penetration: 10mm.
 - .5 Contractor shall submit preservative type and % retention to the Departmental Representative for approval prior to use on the project.
 - .2 Treated material will be rejected if damaged in any manner during handling, including damage, including damage from strapping and slings.
 - .3 Do not make field cuts in treated material unless permitted by the Departmental Representative. When permitted, field treat cuts as soon as possible with preservative specified for the original timber treatment.
 - .4 Treated posts, logs, rails and field drilled holes: when field treating is permitted, field treat to CSA O80, using 2 coats of approved wood preservative.
- .4 Primers: in accordance with manufacturer's recommendations for surface conditions:

- .1 Interior Flat coating or Primer, Green Seal GS-11, VOC limit 50 g/l.
- .2 Interior Non-Flat Coating or Primer, Green Seal GS-11, VOC limit 150 g/l.
- .3 Sealers and under coaters, SCAQMD Rule 1113, VOC limit 200 g/l.

2.2 ACCESSORIES

- .1 Fasteners: to stainless steel Type-316 for all fasteners, unless noted otherwise.
- .2 Anchor rod: to ASTM A307, hot dip galvanized, complete with nuts and washers.
- .3 Side plates: to CAN/CSA-G40.20/G40.21, hot dip galvanized.
- .4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs recommended for purpose by manufacturer. Submit details to Departmental Representative for review and approval.
- .5 Galvanizing: to CAN/CSA-G164, hot dip galvanized, minimum zinc coating of 610 g/m².

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rough carpentry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 All timber or wood products will be pressure treated.
- .2 Treat surfaces of all exterior use timber or wood in contact with concrete, metal and masonry with wood preservative before installation.
- .3 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minutes soak on lumber and 1 minute soak on plywood.

- .4 Re-treat surfaces exposed by cutting, hole drilling, trimming or boring with surface-applied preservative before installation.

3.3 INSTALLATION

- .1 Comply with requirements of NBC 2015, supplemented by the following paragraphs.
- .2 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .3 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.
- .4 Install sleepers as indicated.
- .5 Use caution when working with particle board. Use dust collectors and high quality respirator masks.
- .6 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .7 Countersink bolts where necessary to provide clearance for other work.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

PART 1 - General

1.1 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C764-2019, Mineral Fiber Loose-Fill Thermal Insulation Type 1
- .2 CSA Group
 - .1 CSA B149-2015PACKAGE, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S702-2014, Standard for Mineral Fibre Insulation for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for loose fill insulation and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.
- .3 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports:
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.3 QUALITY ASSURANCE

- .1 Provide one copy of Certification of Coverage and Application Chart in accordance with CAN/ULC-S702 to Departmental Representative, certified by Applicator's signature that the information is correct.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:

- .1 Store materials indoors, off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.

1.5 SITE CONDITIONS

- .1 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
- .2 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of insulation materials.
- .3 Ventilation:
 - .1 Departmental Representative will arrange for ventilation system to be operated during installation of insulation. Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
 - .2 Provide continuous ventilation during application. Run ventilation system 24 hours per day during installation.
- .4 Protection:
 - .1 Provide temporary enclosures to prevent dust from contaminating air beyond application area.
 - .2 Protect adjacent surfaces and equipment from damage by fall-out, and dust.

PART 2 - Products

2.1 MATERIALS

- .1 Mineral fibre insulation: to CAN/ULC-S702, containing a minimum of 70 % recycled content, asbestos-free mineral fibre.
 - .1 Type 4 - pouring wool, suitable for manual application.
 - .2 Type 5 - blowing wool, suitable for application by means of pneumatic equipment.

PART 3 - Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of previously installed loose fill insulation are acceptable for additional loose fill insulation application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 LOOSE FIBRE INSTALLATION

- .1 Pneumatically place loose fibre insulation above existing insulation to provide minimum thickness of 94mm and thermal resistance value RSI 1.94 (R11).
- .2 Ensure unobstructed air circulation to eave vents.
- .3 Install baffles to prevent insulation from spilling over top of exterior wall and causing blockage of soffit vents, and to prevent displacement of insulation by wind entering vents.
- .4 Keep insulation minimum 75 mm from heat emitting devices and recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 chimneys and CSA B149.2 type B and L CSA B149.1 vents.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 Cleaning and Special Cleaning Procedures.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 Cleaning and Special Cleaning Procedures.
 - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.

END OF SECTION

Part 1 General

1.1 SUMMARY OF WORK

- .1 Work of this section includes provision of a 2-ply torch applied SBS membrane over overlay board over existing plywood substrate

1.2 RELATED REQUIREMENTS

- .1 Rough Carpentry Minor Works Section 06 08 99
- .2 Sheet Metal Flashing and Trim Section 07 62 00

1.3 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM C1177/C1177M-2017, Standard Specification for Glass Mat Gypsum Substrate for use as Sheathing.
 - .2 ASTM D 6164-2016 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-9Ma-, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
 - .2 CGSB 37-GP-56M-80b (A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .3 Roofing Contractors' Association of British Columbia R.C.A.B.C. RGC Roofing Practices Manual, guarantee standards.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA-A123.3-05(R2010), Asphalt Saturated Organic Roofing Felt.
 - .2 CSA-A123.4-04(R2018), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
 - .3 CSA O121-2017, Douglas Fir Plywood.
 - .4 CSA O151-2017, Canadian Softwood Plywood.
- .5 Factory Mutual (FM Global)
 - .1 FM Approvals - Roofing Products.
- .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .7 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S704.1-2017, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting two week prior to beginning waterproofing Work, with roofing contractor's representative, membrane manufacturer's representative, and Departmental Representative
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review installation instructions and warranty requirements.
 - .5 Review RCABC warranty certificate requirements

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements, and indicate VOC content for primers.

1.6 QUALITY ASSURANCE

- .1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with minimum 10 years' experience.
- .2 Perform Work to RCABC/RGC practice Manual and manufacturers written instructions.
- .3 Provide only materials listed by RCABC/RGC

1.7 FIRE PROTECTION

- .1 Fire Extinguishers:
 - .1 Maintain one cartridge operated type with shut-off nozzle, on roof per torch applicator, within 6 m of torch applicator.
 - .2 ULC labelled for A, B and C class protection.
- .2 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Requirements.

- .2 Storage and Handling Requirements:
 - .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
 - .2 Provide and maintain dry, off-ground weatherproof storage.
 - .3 Store rolls of membrane in upright position. Store membrane rolls with salvage edge up.
 - .4 Remove only in quantities required for same day use.
 - .5 Place plywood runways over completed Work to enable movement of material and other traffic.
 - .6 Store sealants at +5 degrees C minimum.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.9 SITE CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install roofing when temperature remains below -18 degrees C for torch application, or -5 degrees C for mop application.
 - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.10 WARRANTY

- .1 Upon completion of work, this Contractor shall furnish Owners with a 10-YEAR R.C.A.B.C. Roof Star Guarantee on all work of this section.
- .2 Provide for inspection in accordance with specifications and with R.C.A.B.C. Standards. Inspection fees shall be included in this contract.
- .3 Upon Total Performance of the Contract submit a Twenty (20) year Labour and Materials Warranty issued by the manufacturer of the roofing membrane.

Part 2 Products

2.1 PERFORMANCE CRITERIA

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

2.2 DECK OVERLAY COVERING

- .1 Overlay Board: 7mm thick high density composite panel composed of a non-woven polyester reinforced membrane laminated on a semi-rigid asphaltic board
 - .1 Acceptable Product: Soprasmart Board 180, or approved equal.

2.3 MEMBRANE

- .1 Base sheet: to CGSB 37-GP-56M polyester fibres to ASTM D 6164.
 - .2 Base sheet and base sheet stripping: high performance torch grade modified bitumen base ply designed for use in homogeneous multi-layer modified bitumen roof membrane systems that consists of a reinforcement mat coated with high quality Styrene-Butadiene-Styrene (SBS) Modified bitumen. For field areas, back surface is coated with high performance modified asphalt. Adhesive layer specifically formulated for torch applications and covered with a thermofusible plastic film. For wood or non-torch surface upturn stripping areas.
 - .3 ULC certification: Class A.
 - .4 Acceptable Product: Field : Sopraply 520 base, Siplast - Paradiene 20 TG, or approved equal, Stripping : Soprema - Sopralene Flam Stick, Siplast - Paradiene 20 EGSA, or approved equal.
- .2 Cap sheet membrane: to CGSB 37-GP-56M polyester fibres to ASTM D 6164.
 - .1 Cap sheet and cap sheet stripping: high performance modified bitumen finish ply designed for use in multi-layer modified bitumen roof membrane systems that consists of fiberglass scrim/polyester mat composite coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen and surfaced with ceramic granules.
 - .2 Acceptable Product: Sopraster Flam HD GR, Siplast – Parafor 30 TG, or approved equal.
 - .3 Colour for granular surface: Provide standard cap sheet colour chart to Departmental Representation for roof colour selection

2.4 BITUMEN

- .1 Asphalt: to CAN/CSA A123.4 ASTM D 312, Type 2 3.

2.5 SEALERS

- .1 Sealing compound: rubber asphalt type.
- .2 Caulking

2.6 ROOF CURB

- .1 Prefabricated roof curbs to be manufactured of prime galvanized steel construction, 16 gauge, meeting ASTM A653/653M.
- .2 Welded corners and with seams joined by continuous water and air tight welds. Factory installed nailer and internally insulated with rigid insulation
- .3 305mm height

2.7 FASTENERS

- .1 Overlay board to existing plywood deck: Manufacturers approved screw and plate assemblies.

2.8 CARPENTRY

- .1 Refer to Section 06 08 99 - Rough Carpentry Minor Works

2.9 WALKWAYS

- .1 Walkways to consist of one additional ply of cap sheet membrane. The surface to be protected by black granules and the underface covered with a thermofusible film.
- .2 Heavy duty service membrane, 1.0 meter wide, min. thickness 5.0mm.

Part 3 Execution

3.1 QUALITY OF WORK

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and RCABC Roofing Specification Manual to meet specified Guarantee standards, particularly for fire safety precautions.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 The interface of the walls and roof assemblies will be fitted with durable rigid material providing connection point for continuity of air barrier.
- .4 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.2 EXAMINATION OF ROOF DECKS

- .1 Verification of Conditions:
 - .1 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

- .2 Evaluation and Assessment:
 - .1 Prior to beginning of work ensure:
 - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
 - .2 Curbs have been built.
 - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
 - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
 - .3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 DECK OVERLAY

- .1 Mechanically fasten to existing plywood with screws and plates, spaced 400 mm on centre each way
- .2 Fasteners must be installed on the distinctive line of the membrane side selvedge

3.5 CONVENTIONAL MEMBRANE ROOFING

- .1 Base sheet application:
 - .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
 - .2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
 - .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
 - .4 Application to be free of blisters, wrinkles and fishmouths.
- .2 Cap sheet application:
 - .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
 - .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
 - .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

- .4 Application to be free of blisters, fishmouths and wrinkles.
- .5 Do membrane application in accordance with manufacturer's recommendations.
- .3 Flashings:
 - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
 - .2 Torch base and cap sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
- .4 Roof penetrations:
 - .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.6 FIELD QUALITY CONTROL

- .1 Inspections:
 - .1 Inspection and testing of roofing systems and application will be carried out by testing laboratory designated by Departmental Representative.
 - .2 Inspection will be carried out during the entire roof installation procedure.
 - .3 Manufacturer's Representative to complete review of basesheet installation prior to cap sheet installation.
 - .4 Manufacturer's Representative to complete review of cap sheet installation.

3.7 CLEANING

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

- .3 Repair or replace defaced or disfigured finishes caused by work of this section.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Place materials defined as hazardous or toxic in designated containers.
 - .2 Ensure emptied containers are sealed and stored safely.
 - .3 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.
 - .5 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Modified Bituminous Membrane Roofing Section 07 52 00

1.2 REFERENCES

- .1 The Aluminum Association Inc. (AAI)
- .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
 - .2 AAI DAF45-03, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A 792/A 792M-10 (2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .3 Roofing Contractors Association of B.C. (RCABC)
- .1 RGC Roofing Practice Manual.
- .4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
- .5 Canadian Standards Association (CSA International)
- .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .6 Green Seal Environmental Standards
- .1 Standard GS-03-1997, Anti-Corrosive Paints.
 - .2 Standard GS-11-2015, Architectural Paints.
 - .3 Standard GS-36-2013, Commercial Adhesives.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).
- .8 British Columbia Sheet Metal Association (SMACNA-BC)
- .1 Architectural Sheet Metal Manual- 7th Edition 2012.

1.3 SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33- - Health and Safety Requirements.
- .3 Samples:
 - .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 **QUALITY ASSURANCE**

- .1 Pre-Installation Meetings: convene pre-installation meeting [one] week prior to beginning work of this Section and, with contractor's representative, Departmental Representative in accordance with Section 01 01 50 – General Requirements to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building sub trades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Upon completion of work, this Contractor shall furnish a 10 year R.C.A.B.C. guarantee work of this section.
- .3 Provide for inspection in accordance with specifications and Consultant's Standards. Include inspection fees in this contract. Inspection agency to be selected from R.C.A.B.C. approved list of roofing inspectors.

1.5 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2

Products

2.1

PRE-FINISHED SHEET METAL

- .1 Zinc coated steel sheet: 0.61 mm (24ga) thickness, commercial quality to ASTM A 792, with Z275 designation zinc coating, finish enamel coated factory applied coating to CGSB 93-GP-3m Class F29, colour to be selected by Departmental Representative.

2.2

ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.
- .3 Underlay for metal flashing: asphalt laminated 3.6 to 4.5 kg kraft paper.
- .4 Sealants.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.
- .5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .6 Fasteners: stainless steel, flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.

2.3

FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC and SMACNA Standards. Guarantee standard as specified in 1.4 Quality Assurance.
- .2 Form pieces in 2400 mm maximum lengths.
 - .1 Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm.
 - .1 Mitre and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.4 METAL FLASHINGS

- .1 Form flashings, copings and fascia to profiles indicated of galvanized steel as indicated on drawings.
- .2 Caulk perimeter flashings with specified sealant where necessary to make a proper seal.
- .3 'S' Lock and caulk end joints in flashing. Provide standing seams with concealed clips at corners. Hem exposed edges of flashing a minimum of 12.5 mm for rigidity.
- .4 Provide flashings with edges turned to form a drip. Make proper allowance for expansion and contraction. Face clip flashings with concealed clips (600 mm) on centres.
- .5 Provide flashings at vents, chimneys and control joints.
- .6 Carry face metal down exterior face a minimum of 100 mm or as indicated on drawings.
- .7 Provide metal base and cap flashings to extend to within 25 mm of roof surface.
- .8 At vent stacks, install aluminum vent stacks and include for aluminum metal caps.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with R.C.A.B.C standards and SMACNA best practice.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over hook strips.
- .5 Lock end joints and caulk with sealant.
- .6 Install pans, where shown around items projecting through roof membrane.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning and Special Cleaning Procedures.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 General

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 The General Conditions, Supplements, Amendments and Mechanical General Requirements shall govern the plumbing sections of the work. Read in conjunction with the Instructions to Tenderers or Bidders.
- .3 Provide sanitary drainage, sanitary venting, natural gas, and all other piping, fixtures and equipment as specified below or as shown on the drawings.
- .4 Plumbing drawings are diagrammatic and approximately to scale. They establish the scope of the plumbing work and the general location and orientation of the plumbing facilities. Plumbing facilities shall be installed generally in the locations and generally along the routings shown, close to the building structure with minimum interference with other services. Piping shall be concealed within walls, ceilings or other spaces and shall be routed to maximize head room and the intended use of the space through which they pass, unless specifically noted otherwise.

1.2 Related Sections

- .1 Division 01 – General Requirements.
- .2 Section 21 05 00 – Common Work Results for Fire Suppression
- .3 Section 22 13 00 – Sanitary Waste and Storm Drainage System
- .4 Section 23 05 00 – Common Work Results for HVAC
- .5 Section 23 05 29 – Hangars and Support for Mechanical Equipment and Piping
- .6 Section 23 07 16 – Thermal Insulation for Piping

1.3 Codes, Standards and Approvals

- .1 Installation, workmanship and testing shall conform to the following (in cases of conflicting requirements, the most stringent shall apply):
 - .1 British Columbia Building Code BCBC-2018
 - .2 National Building Code of Canada NBCC-2015
- .2 National Plumbing Code 2015
- .3 Authority Having Jurisdiction
- .4 ULC and FM Standards for applicable products
- .5 CSA Standards for applicable products

1.4 Shop Drawings and Samples

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Shop drawings are required for:
 - .1 Pipe, fittings and couplings
 - .2 Fire-stopping system and product data sheets
 - .3 Pipe insulation
 - .4 Pipe identification
 - .5 Submit samples for:
 - .1 A 300 mm to 450 mm length of each type of pipe material for each system, both above ground and below ground.
 - .2 A 90 deg. fitting (and a coupling where applicable) for each type of material and for each type of piping system.
 - .3 Valves up to 50 mm nominal size.
 - .4 Pipe identification for each system, and two valve tags.
 - .6 All other system components and accessories

1.5 Maintenance Data

- .1 Provide maintenance data summarized below for incorporation into the Mechanical Operating and Maintenance Manual.
- .2 Include detailed instructions for the normal maintenance of all installed equipment including operational procedures, frequency of operational checks, service instructions and troubleshooting instructions.
- .3 Local source of supply for each item of equipment indicating company, location, manufacturer's representative, phone number and e-mail address.
- .4 Labeling and identification schedules.
- .5 Valve schedule; including location, service type and normal valve position for all systems.
- .6 Warranties, certificates, and miscellaneous reports.
- .7 Manufacturer's catalogue data sheets including a copy of the reviewed shop drawings of each component plus operating and maintenance brochures, including wiring diagrams.
- .8 Comprehensive description of the operation of the system including the function of each item of equipment within the system.
- .9 Operating electrical switchgear schedule indicating location of equipment.

- .10 Lubrication schedule indicating the recommended lubricants and grades (grease or oil) for all lubricated equipment components.
- .11 Test reports for all sections of piping.

1.6 Record Drawings

- .1 Comply with requirements contained in Division 1.
- .2 Maintain one set of contract drawing white prints, including all supplementary and revision drawings on site, solely for the purpose of recording, in red, any change and/or deviation from the Contract Drawings as it occurs.
- .3 The set of white prints will be provided to the contractor by the Departmental Representative at the contractor's cost.
- .4 The marked-up set of prints will be reviewed on site by the Departmental Representative during the construction process. This review may form a requirement for approval of the monthly progress claim.
- .5 Backfilling shall not occur until underground services are surveyed.
- .6 The Record Drawings shall include, but not limited to, the following changes and shall be recorded daily:
 - .1 Size, location, arrangement, routing and extent of piping, fixtures, drains, clean-outs, rough-in, etc. above and below grade inside and outside the building and including dimensioned locations of buried piping from building walls and gridlines.
- .7 CAD Drafting:
 - .1 Refer to Section 23 05 00 for additional requirements to those listed below.
 - .2 Include all details from revision drawings, addenda, and change orders. Label each drawing in the lower right corner in letters of at least 12mm high as follows:
"AS BUILT DRAWINGS", Contractors name and date.
 - .3 Provide one set of check prints for review by the Departmental Representative.
 - .4 Upon review of the drawings by the Department Representative, provide computer CAD files on a CD and four sets of hard copy plots.

1.7 Substantial Performance Requirements

- .1 Before the Department Representative is requested to make a field review for substantial performance of the work:
 - .1 Submit signed test forms for all sections of the piping.

- .2 Submit completed marked up Record Drawings.
- .3 Submit a letter on the Contractor's letterhead certifying that all work is complete.

1.8 Deficiency Holdbacks and Deficiency Field Reviews

- .1 Work under this Division which is still outstanding when substantial performance is determined will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is required that outstanding work be completed in an expeditious manner and the entire holdback sum may be retained until the requirements for Total Performance of Division 22 work have been met and verified.

1.9 Occupancy Requirements

- .1 Before the Department Representative is requested to submit their Schedule C-B as related to the occupancy permit, the contractor shall submit at least of the following documentation:
 - .1 All shop drawings.
 - .2 Piping system test certificates.
 - .3 Firestopping certificate.
 - .4 Seismic Schedules B-1, B-2 and C-B.
 - .5 Mechanical O&M manual.
 - .6 As-built drawings.

1.10 Connection Fees

- .1 There are no municipal connection fees related to this project work.

1.11 Temporary Usage of Plumbing Systems and Equipment

- .1 Plumbing systems and equipment shall not be used without the written permission of the Departmental Representative and in no circumstances shall be used prior to testing and inspection.

1.12 Chromium Plated Piping

- .1 Use only strap wrenches on chromium plated pipe or fittings. Surfaces damaged by wrench marks shall be replaced. Joints shall be threaded or slip joints.

1.13 Acoustical Treatment

- .1 General
 - .1 This project includes special acoustical requirements to ensure low noise levels in noise sensitive areas. The contractor shall in particular give careful consideration to equipment selection and pay close

attention to detail during the rough-in stage in order to assure maximum acoustical benefit.

- .2 The insulation for wall, ceilings, and pipe chases as outlined herein is to be provided and installed under another division of work. This section is responsible for ensuring that all special requirements for plumbing systems have been met before the walls or ceilings have been closed in.

- .2 Summary of Requirements

- .1 Drain, Waste:

- .1 Cast iron pipe and mechanical joint fittings shall be used. Plastic, copper, and aluminum DWV piping are unacceptable. Waste piping over sound sensitive areas shall be provided with a minimum 150 mm long section of minimum 12 mm thick 50 durometer closed cell neoprene insulation, bearing on a minimum 150 mm long preformed galvanized steel load distribution shields at each pipe hanger.

- .2 Waste connections from appliances and fixtures may be copper to the waste stack.

- .2 Pipe Sizes:

- .1 The minimum pipe size to faucets or mixing valves of each fixture shall be 12 mm. The use of 9 mm pipes is strictly prohibited.

- .3 Fastening to the structure:

- .1 Piping shall not contact any concrete, concrete block, framing, stud or wall surface; or any other conduit, electrical fixture or ventilation duct that is connected to any wall or ceiling surface.

- .2 Piping shall not be fastened to a partition which forms part of an adjacent room not served by the pipe in question. Do not secure piping to gypsum wallboard or its supporting frame.

- .3 Riser clamps shall be isolated from the structure using an approved resilient material between the support collar and the floor structure (Vibro-Acoustics type SN, 30 durometer, 57 mm x 57 mm in size, or an approved equal). An alternate method is to wrap the pipe with neoprene prior to clamping.

- .4 Pipe hangers shall be oversized to suit the insulation thickness and shall have a preformed galvanized steel load distribution shield between the insulation and the hanger.

- .4 Clearance Around Pipes:
 - .1 All pipe (bare or insulated) shall be clear of contact with concrete, concrete block, studs or gypsum wallboard.
 - .2 Pipes in acoustically critical walls shall be wrapped with a minimum thickness of 6 mm of Armaflex or Rubatex sleeving and secured by use of oversized clamps. This is not necessary where the piping is insulated provided that pipe clamps are mounted around the exterior of the insulation. Hard plastic pipe sleeves shall not be used.
- .5 Wall and Slab Penetrations by Pipes:
 - .1 Pipes penetrating slabs or rated concrete or concrete block wall shall be mineral fiber wrapped prior to firestopping.
 - .2 Gypsum wallboard or plaster wall pipe penetrations shall be 3 mm to 6 mm oversized with the pipe centred in the hole and the gap caulked with silicone or other non-hardening sealant for unrated separations, and firestopping for rated separations.
 - .3 Pipe expansion joints shall be for noise free operation.
- .6 Ceiling, Wall, and other Plumbing Pipe Chases:
 - .1 The interior spaces shall be insulated with non-compressed RSI 2.11 [R-12] batt insulation in the following proportions:
 - .1 Ceiling plenum - 80% of area.
 - .2 Chases - 100% of all four vertical surfaces.
 - .3 Walls - 50% of space containing pipe, and 100% of adjacent stud space.

1.14 Seismic Protection

- .1 Supply and install sway-bracing hangers on the following systems:
- .2 This shall apply to all cross-mains including loops, 50 mm and larger, and shall apply to feed mains including risers. Horizontal piping shall be 2-way bracing and vertical piping shall include 4-way bracing at the tops of the risers. Spacing of horizontal 2-way sway braces shall not exceed 12 metres. On floor loops sway-braces are also required at the corners of the loops.
- .3 Seismic restraints shall meet the requirements of section 23 05 49 Seismic Restraints.
- .4 Arrange and pay for the services of a B.C. Registered Professional Engineer. This seismic engineer shall provide all required engineering services related to seismic restraints of non-vibration isolated plumbing

equipment and piping. The seismic engineer shall provide assistance to the contractor as necessary during the course of restraint of equipment and piping. The seismic engineer shall provide field reviews of the work during construction and the completed seismic installation.

- .5 Submit signed and sealed Schedule B to the Department Representative at the beginning of the project and Schedule C-B at completion of the project, a minimum of 10 working days prior to Occupancy.

1.15 Building Operation during Construction

- .1 In order to minimize operational difficulties for the existing building and the staff, the Contractor must cooperate with the Departmental Representative throughout the entire construction period and particularly ensure that noise is minimized.
- .2 Minor inconvenience and interruption of services will be tolerated, provided advance notice is given to the Departmental Representative, but the Contractor will be expected to coordinate their work, in consultation with the Departmental Representative, so the operation of the existing facility can be maintained as nearly normal as possible.

1.16 Existing Services

- .1 Protect all existing services encountered and be responsible for any damages to existing systems by the work of this contract. Obtain instructions from the Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .2 Arrange work to minimize shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's written approval of the timing, and work to minimize any interruptions.
- .3 In order to maintain existing services in operation, temporary relocations, temporary valves and/or bypasses of piping may be required.
- .4 The Departmental Representative reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting off of a service will interfere with important operations.

1.17 Connection to Existing Systems on this Site

- .1 These documents include work that will require connections of piping systems to existing systems including the natural gas connection at the existing gas line and meter upgrade. See site plan for details.
- .2 Provide all necessary excavation, coring, piping adjustments and offsets as required to connect to those services. Report any major discrepancies to the Departmental Representative.

- .3 Cooperation with respect to on-site coordination of all piping connections is an integral part of the responsibility of this section of the work all within the basic tender price. No extra cost will be allowed based on a failure to allow for scheduling and coordination of piping connections to produce a complete workable system whether shown on the drawings or not.
- .4 Coordinate with the gas utility company for upgrade of gas meter station if required. Provide a lamicaid label on the main isolation valve to the new building labeled in accordance with the requirements of the Departmental Representative.

1.18 Firestopping

- .1 Provide firestopping for all plumbing penetrations of rated separations to CAN4 S-115.

Part 2 Products

2.1 General

- .1 All materials shall be new and of the condition as originally manufactured free of defects.

2.2 Non-security Access Doors

- .1 Not used.

2.3 Hangers and Supports

- .1 Hanger Supports:
 - .1 Carbon steel construction.
 - .2 Adjustable for proper grading.
 - .3 Rods shall be cadmium plated with continuous thread in accordance with ANSI B-31. Hanger types:
 - .1 Up to 25 mm.
 - .2 30 mm and larger.
 - .3 Hangers for metallic non-ferrous pipe shall be plated and plastic dipped or the pipe shall be wrapped for a minimum 150 mm length centered on the hanger with Polyken tape.
- .2 Wall Supports:
 - .1 Horizontal pipes adjacent to walls: Angle iron wall brackets with specified hangers.
 - .2 Vertical pipes adjacent to walls:
 - .1 Exposed pipe wall guide.
 - .2 Channel type supports.

- .3 Floor Supports:
 - .1 Vertical pipe.
 - .1 Risers where they pass through floors shall be standard riser clamps.
 - .2 Base of risers where they are adjacent to and above floor slabs shall be adjustable fabricated steel floor supports.
 - .3 Provide load bearing plates below riser clamps c/w factory mounted neoprene rubber to minimize noise transmission.
 - .4 Inserts, Anchors, and Beam Clamps:
 - .1 Select for the application and load.
 - .2 Do not use explosive type inserts unless permitted by the Departmental Representative.

2.4 Pipe Sleeves and Escutcheons

- .1 Non-combustible pipe penetrations through fire separations that are required to have a fire resistance rating shall be firestopped to ULC/CAN4 S-115.
- .2 Combustible pipe penetrations through fire separations that are required to have a fire resistance rating shall be as follows:
 - .1 Intumescent firestopping material contained in a metal housing that is certified per ULC/CAN4 S-115 for firestopping use. Installation shall be implemented in full compliance with the certified installation procedures.
- .3 Pipe penetrations through separations that are not required to have a fire resistance rating shall be as follows:
 - .1 Interior concrete or block wall sleeves and floor slab sleeves in dry areas shall be steel pipe or removable plastic pipe and sealed with silicone.
 - .2 Floor slab sleeves in wet areas, outside wall sleeves and roof slab sleeves shall be steel pipe and sealed with silicone.

2.5 Miscellaneous Metal Related to Plumbing Systems

- .1 Frames shall be of welded construction consisting of angle iron sections with 8 mm locating strips and anchoring lugs at a minimum of 900 mm centres.
- .2 Backing Plates shall be adequate to support the use intended and shall be a minimum 4.8 mm in thickness.

2.6 Sanitary Waste Piping

- .1 Install minimum 150 mm diameter sanitary piping from all water closets.

- .2 Minimum 1.5% slope on all sanitary piping.
- .3 Install offsets in nominally horizontal pipe utilizing a 1 meter long section of pipe between successive 45 degree changes of direction, to minimize blockages. Do not install a wye and 45 degree fitting or two 45 degree fittings in close succession.
- .4 Install cleanouts generally in secured areas.

Part 3 Execution

3.1 Piping Installation

- .1 General:
 - .1 Install piping straight, parallel, and close to walls and ceilings.
 - .2 Install sanitary piping with a slope of not less than 1.5% for gravity piping below grade, not less than 1% for all other gravity piping 100 mm and larger, and not less than 2% for all other gravity piping 75 mm and smaller.
 - .3 Provide a slope to drain cocks, fixtures or equipment for all water supply and pressure piping unless otherwise indicated on drawings.
 - .4 Install groups of piping parallel to each other; spaced to permit application of insulation, identification, and service access, on trapeze hangers.
 - .5 Where sizes differ from pipe sizes to equipment connection sizes, install reducing fittings close to the equipment. Reducing bushings are not permitted.
 - .6 Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.
 - .7 Ream ends of pipe and tubes before installation.
 - .8 Lay copper pipe and tubing so that it is not in contact with dissimilar metal or in direct contact with concrete, and will not be crimped or collapsed.
 - .9 All joints on cast or ductile iron pressure service piping shall be made electrically conductive.
 - .10 Install flanges or unions to permit removal of equipment and serviceable components without disturbing piping systems.
 - .11 Clean the ends of pipes or tubing and the recesses of fittings to be jointed. Assemble joints without binding.
 - .12 Install piping to connections at fixtures, equipment, outlets, and all other appurtenances requiring service. Trap and vent waste connections to fixtures. Grade all vents to drain back to waste piping.

- .13 Plug or cap pipe and fittings to keep out debris during construction.
- .14 Jointing of pipe shall be compatible with type of pipe used.
- .15 Non-corrosive lubricant or teflon tape shall be applied to the male thread of threaded joints.
- .16 Flush and clean out piping systems after testing.
- .2 Equipment Drainage:
 - .1 Install drain valves at low points.
 - .2 Extend equipment drain piping to discharge into floor or hub drains.
- .3 Expansion and Contraction:
 - .1 Support piping to prevent any stress or strain.
 - .2 Install pressure piping with loops and offsets which will permit expansion and contraction to occur without damaging the pressure piping system

3.2 Hangers and Supports

- .1 On insulated piping larger than 25 mm diameter where the insulation possesses a continuous vapour barrier, install oversized hangers and insulation protection shields of thickness and length as recommended by the manufacturer. On insulated piping 25 mm diameter and less protect contact between pipe and hanger and fit insulation tightly around hanger rod penetration through insulation.
- .2 Maximum hanger spacing: (maximum spacing for cast or ductile iron is 1.5 metres.

Pipe Size MM	Rod Dia. MM	Steel M	Copper M	PVC M
To 18	9	1.5	1.5	1.05
25-30	9	2.1	1.8	1.2
40-50	9	2.7	2.4	1.2
65-75	12	3.3	3.0	1.2
100-125	15	4.2	3.6	1.2
150	20	5.2	1.2	
200-250	22	5.8	1.2	

- .3 Do not support horizontal piping runs from the floor unless specifically indicated.

3.3 Pipe Sleeves and Escutcheons

- .1 Sleeves shall be concentric with the pipe and shall be sized to allow for the continuity of insulation.
- .2 Extend sleeves 50 mm above floor slabs in wet areas. Wet areas include equipment rooms, janitor's rooms, utility rooms and plumbing service chases.
- .3 Extend sleeves through outside walls to 12 mm beyond the exterior face and caulk with flexible caulking compound.
- .4 Where removable plastic sleeves are used they shall be removed prior to pipe penetration and the resulting hole shall be then classified as the sleeve.
- .5 Install chrome plated escutcheon plates on exposed piping passing through walls, floors, and ceilings in finished areas.

3.4 Core Drilling and Cutting

- .1 The work of this contract shall include for all required coring to accommodate the plumbing works, where sleeves have not been provided in a timely manner.
- .2 Arrange and pay for the cost of all core drilling and cutting for plumbing systems in this section of the work.
- .3 Coring and cutting of structural building components shall only take place upon the receipt of specific written approval of the Departmental Representative. Repairs to existing services damaged as a result of core drilling is included in this section of the work.
- .4 Penetrations up to 150 mm nominal pipe size in precast concrete may be cored on site. Larger penetrations shall be located and arranged for in precast work with precast manufacturer prior to shipping to construction site.

3.5 Miscellaneous Works Relating to Plumbing Systems

- .1 All miscellaneous metal related to the plumbing systems including, all metal back up plates and supports for all ceiling or wall supported equipment or plumbing fixtures, all steel covers, or cages to protect exposed piping subject to mechanical damage is part of this section of the work.
- .2 Prime coat after fabrication with two coats of red primer.
- .3 See separate division of specification for finish painting requirements.
- .4 Provide blocking at all fixture stops and anchor the supply lines using dog ear elbows.

3.6 Piping Expansion

- .1 All piping systems, including all take-offs shall be so installed within the building that the piping and connected equipment will not be distorted by expansion, contraction or settling.
- .2 If circumstances on the job require additional changes in direction from those shown on the drawings, the configuration shall be adjusted to suit at no extra cost.
- .3 Anchors shall be installed where necessary to control expansion. Expansion joints or loops shall be installed on hot water supply and recirculation piping where required.

3.7 Testing and Inspection

- .1 Give written 72 hour notice to the Departmental Representative of dates for tests.
- .2 Do not conceal work until tested and reviewed. Follow the construction schedule and arrange for tests.
- .3 Conduct tests in the presence of the Departmental Representative or their representative. Arrange for the Departmental Representative to be present at their discretion.
- .4 Bear all costs for testing including retesting and making good.
- .5 Provide copies of written reports for all sections of the work as it is tested, and retain a copy of all test reports on site.
- .6 Furnish all labour, materials, instruments, etc. necessary for all required tests.
- .7 All leaks shall be corrected by remaking the joints. The systems shall be retested until no leaks are observed.
- .8 If any plumbing system or part thereof is covered before being inspected or approved, it shall be uncovered at no additional cost to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Work and conditions common to Division 23.

1.2 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Division 26 – Electrical.
- .3 Section 21 05 00 – Common Work Results for Fire Suppression.
- .4 Section 22 05 00 – Common Work Results for Plumbing.
- .5 Section 23 08 00 - Commissioning of Mechanical Systems.
- .6 Section 23 05 49 - Seismic Restraints.

1.3 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.4 WORK INCLUDED

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .2 Provide materials, equipment, and plant, of specified design, performance, and quality; and, current models with published certified ratings for which replacement parts are readily available.
- .3 Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .4 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed, and furnished unless otherwise ordered by the Departmental Representative in writing during the bidding period.
- .6 All work shall be in accordance with the Project Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment, piping, and ductwork.

- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

1.5 SUSTAINABLE REQUIREMENTS

- .1 Follow instructions and initiatives such as pollution preventions and recycling of materials, packaging, and debris.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Perform in accordance with Section 01 74 19 Waste Management and Disposal,

1.7 COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed.
- .2 Coordinate work with all trades and make changes to facilitate a satisfactory installation.
- .3 The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or only shown diagrammatically, the pipes and ductwork shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines.
- .4 All ducts and pipes in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All pipes and ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

1.8 HOISTS AND SCAFFOLDS

- .1 Provide all necessary interior movable or roller scaffolds, platforms, lifts and ladders for the installation of the mechanical work.

1.9 INSPECTION OF WORK

- .1 The Departmental Representative shall inspect all work prior to it being concealed. All piping below ground must be approved prior to covering.
- .2 All work shall be approved by all authorities having jurisdiction.
- .3 All openings shall be sealed appropriately in particular in fire rated walls and floors. Sealing shall be inspected prior to covering.

1.10 PERMITS

- .1 Obtain all required permits and pay all fees therefore and comply with all Provincial, Municipal, Federal, and other legal regulations and bylaws applicable to the work.

- .2 Arrange for inspection of all Work by the Authority Having Jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.11 CODES, REGULATIONS AND STANDARDS

- .1 Division 23 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction. The latest revision of each code and standard shall apply unless otherwise specified in the contract documents.
- .2 Installation, workmanship, and testing shall conform to the following (in cases of conflicting requirements, the most stringent shall apply):
 - .1 National Building Code of Canada NBCC-2015
 - .2 British Columbia Building Code BCBC-2018
- .3 Canadian Gas Association
 - .1 National Standard of Canada CAN/CGA-B149.1-15. - Natural Gas Installation Code.
- .4 Canadian Standards Association
 - .1 CSA Standard C22.1-18- Canadian Electrical Code.
 - .2 CSA Standard B51-19- Boiler, Pressure Vessel and Pressure Piping Code.
- .5 National Research Council of Canada
 - .1 NRCC National Building Code of Canada 2015.
- .6 SMACNA Publications
 - .1 Guidelines for seismic restraints of mechanical systems.
- .7 Where these specifications specifically indicate requirements more onerous than the aforementioned codes, these specifically indicated requirements shall be incorporated into the work.

1.12 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period described in Division 01 and General conditions, which shall include one (1) complete summer and one (1) complete winter of uninterrupted scheduled operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.

- .4 The Contractor shall, at its own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the guaranty-warranty.

1.13 ENERGY CONSUMPTION

- .1 The Departmental Representative may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

1.14 WORKMANSHIP

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

1.15 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

- .1 Installed mechanical equipment whose performance is questioned by the Departmental Representative, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Departmental Representative will determine by whom testing shall be carried out. When requested, the contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be reviewed by the Departmental Representative.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.
- .6 Promptly provide the Departmental Representative with all test reports.
- .7 Should test results reveal that originally installed equipment meets specified performance requirements; the Departmental Representative will pay all costs resulting from performance verification procedure.
- .8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:

- .1 Remove rejected equipment. Replace with equipment, which meets requirements of Contract Documents including specified performance requirements.
- .2 Replacement equipment will be subject to performance verification as well; using the same testing procedures on originally installed equipment.
- .3 Contractor shall pay all costs resulting from performance verification procedure.

1.16 SHOP DRAWINGS/PRODUCT DATA

- .1 In accordance with Section 01 33 00 Submittal Procedures.
- .2 Process
 - .1 Shop drawings/product data shall be submitted for all H.V.A.C., Plumbing Equipment and materials.
 - .2 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Departmental Representative.
 - .3 Do not order equipment or material until the Departmental Representative has reviewed and returned shop drawings.
 - .4 Shop drawings shall be reviewed by the General Contractor and Mechanical Sub-Contractor indicating that the shop drawings have been reviewed, co-ordinated with the work and that the shop drawings are submitted without qualifications. Shop drawings shall bear the 'reviewed' stamp dated and initialled by the General Contractor and Mechanical Sub-Contractor prior to submitting the shop drawings to the Departmental Representative. Shop drawings, which do not bear the contractors and sub-trades 'reviewed' stamp, initials and date will be rejected and sent back as 'not reviewed'.
 - .5 Submit samples, in addition to drawings, of all items, which in the Departmental Representative's judgment, can be better examined for capacity, quality, finish or detail by sample rather than by drawings. Samples shall be submitted before equipment or material is ordered.
 - .6 If shop drawings are rejected technically after 2 submissions, the Contractor at no additional expense to the Departmental Representative shall revert to the product as instructed by the Departmental Representative.
- .3 Content
 - .1 Shop drawings submitted title sheet. Identify section and paragraph number.

- .2 Data shall be specific and technical.
- .3 Identify each piece of equipment.
- .4 Information shall include all scheduled data.
- .5 Material for maintenance and operating manuals is not suitable.
- .6 Advertising literature will be rejected.
- .7 The project shall be identified on each document.
- .8 Information shall be given in S.I. units (Imperial Units optional, in brackets).
- .9 The shop drawings/product data shall include:
 - .1 Clearly mark submittal material using arrows, underlining, or circling to show differences from specified ratings, capabilities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps, seals, material, finish, or painting.
 - .2 Dimensioned construction drawings with plans and sections showing size, arrangement, and necessary clearances, with mounting point loads.
 - .3 Mounting arrangements.
 - .4 Detailed drawings of bases, supports and anchor bolts.
 - .5 Capacity and performance characteristics indicated on performance curves for fans and pumps.
 - .6 Sound Power Data, for all noise generating equipment and where requested.
 - .7 Motor efficiencies on motors 1H.P. and larger.
 - .8 List of the manufacturers and figure numbers for all valves, traps, and strainers.
 - .9 Control explanation and internal wiring diagrams for packaged equipment.
 - .10 Control system drawings including a written description of control sequences relating to the schematic diagrams.
 - .11 Submit as a shop drawing, an electrical equipment list for any equipment supplied by the mechanical contractor or his subtrades. The list is to be submitted in a timely fashion so that the electrical contractor can utilize the list as a final check prior to ordering motor control centres, starters, or disconnects. The list is to indicate the following:

- .1 The horsepower size and number of motors.
 - .2 The minimum circuit amps (MCA) for packaged equipment such as heat recovery units, chillers, etc.
 - .3 The voltage and phase of the motors.
 - .4 Whether or not a starter or a disconnect is included as part of the package.
- .4 Format
- .1 Black line prints 216 mm x 280 mm or 280 mm x 430 mm.
 - .2 Larger drawings may be submitted on reproducible sepia with space for stamps and signatures - master set plus one working copy.
 - .3 An assembly of related components, e.g. grilles, registers and diffusers or radiation with sheet metal cabinets, etc. between covers with the contents, identified by model number, listed on the front cover with item identification numbers.
 - .4 A brochure for plumbing fixtures between covers with the contents named with model numbers listed on the front cover with item identification numbers.
- .5 Number of copies
- .1 Provide number of copies indicated in Section 01 33 00 - Submittal Procedures.
- .6 Coordination
- .1 Where mechanical equipment requires electrical connections, power or other services, the shop drawings shall also be circulated through the Electrical Contractor (or other "services" contractor(s)) prior to submission to the Department Representative.
- .7 Keep one (1) copy of shop drawings and product data, on site, available for reference.

1.17 DUCT AND PIPE MOUNTED CONTROL EQUIPMENT

- .1 The following automatic control equipment will be supplied by the Controls Contractor, under Division 23, but installed by the appropriate trade sections of the Mechanical Contract:
 - .1 Automatic control valves.
 - .2 Temperature control wells.
 - .3 Pressure tappings.
 - .4 Flow switches.

- .5 Static pressure sensors.

1.18 SPARE PARTS

- .1 Provide spare parts as follows:
 - .1 One set of V-belts for each piece of machinery.
 - .2 One filter for each filter installed.

1.19 PROJECT CLOSE-OUT REQUIREMENTS

- .1 In accordance with Section 01 77 00 Closeout Procedures and 01 78 00 Closeout Submittals.
- .2 The project closeout requirements are specifically listed in each section of this specification. The following is a summary of those requirements. Refer to detailed specifications in each section for further, detailed requirements. All life safety systems must be operational and tested and demonstrated to the Departmental Representative.
 - .1 Controls:
 - .1 Controls system completion report (check sheets).
 - .2 Controls system final electrical approval certificate.
 - .3 As built control drawings.
 - .4 Control training signed off by Departmental Representative (Indicate dates of training in letter and attendance).
 - .5 List of control manuals and documents turned over.
 - .6 Printed copy of control program and database (printed to disk in word format is acceptable).
 - .7 Disc of control system database.
 - .2 Heating
 - .1 Gas fired appliances/gas line/pressure piping certificate.
 - .2 Seismic inspection report.
 - .3 As built drawings.
 - .3 Manufacturer's start-up and other reports including:
 - .1 Commissioning.
 - .2 Testing and Balancing Report
 - .3 Seismic letter of assurance.
 - .4 Sprinkler letter of assurance.
 - .5 Fire stop letter of assurance.

1.20 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
 - .1 Commission all systems and prove out all components, interlocks, and safety devices.
 - .2 Submit a letter certifying that all work (including calibration of instruments and balancing of systems) is complete, operational, clean and all required submissions have been completed.
 - .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Testing and balancing completed.
 - .3 Operating and Maintenance Manuals completed.
 - .4 "As Built" Record Drawing ready for review.
 - .5 System Commissioning has been completed and has been verified by the Departmental Representative.
 - .6 All demonstrations to the Departmental Representative have been completed.
- .3 The work will not be considered to be substantially complete until the following requirements have been met:
 - .1 All items listed in .1 and .2 above have been completed.
 - .2 Gas Inspection - Certificate of inspection.
 - .3 Seismic letters of Assurance and final inspection report.
 - .4 Certificate of Substantial Performance.
 - .5 Signed off copy of final inspection report.

1.21 OPERATING AND MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into complete project manuals.
- .2 Definition: detailed information and records of individual products provided by manufacturer or supplier as part of project requirements, and of systems, describing operation and maintenance of each item.

- .3 Operating data to include:
 - .1 Environmental and other control schematics for each system.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operating instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Colour coding chart.
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operating and trouble-shooting instructions for each item of equipment.
 - .2 Equipment manufacturer's performance data sheets.
 - .3 Equipment performance verification test results.
- .5 Approvals:
 - .1 Submit (2) drafts of Operating and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by the Departmental Representative.
 - .2 Make any changes in submission as may be required and re-submit as directed.

1.22 RECORD DRAWINGS

- .1 Site records:
 - .1 Provide and maintain sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur.
 - .2 On a weekly basis, transfer information to reproducibles using services of skilled draftsman revising reproducibles to show all work as actually installed.
 - .3 Make these drawings available for reference purposes and to inspection at all times.

Part 2 Products

NOT USED

Part 3 Execution

3.1 CONCEALMENT

- .1 Conceal all piping, ductwork and conduit in partitions, walls, crawlspaces, and ceiling spaces, unless otherwise noted.

- .2 Do not install piping and conduit in outside walls or roof slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.

3.2 ACCESSIBILITY

- .1 Install all work so as to be readily accessible for adjustment, operation and maintenance. Furnish access doors where required in building surfaces for installation by building trades. Refer to item "Access Doors".

3.3 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust, and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of piping, ductwork, and conduits, as installation work progresses.
- .3 Equipment having operating parts, bearings, or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.
- .5 Air systems to have air filters installed before fans are operated. Install new air filters before system acceptance.

3.4 CUTTING, PATCHING, DIGGING, CANNING AND CORING

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the mechanical services. Coordinate with other Divisions.
- .2 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors, roof, and walls. Openings through structural members of the building shall not be made without the approval of the Departmental Representative.
- .3 Be responsible for correct location and sizing of all openings required under Division 23, including pipe sleeves and duct openings. Allow oversized openings for fire dampers and pipe penetrations where insulation is specified.
- .4 Verify the location of existing service runs and steel reinforcing within existing concrete floor, roof, and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the mechanical services.
- .6 All openings shall be core drilled or diamond saw cut.

3.5 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa (refer to structural drawings).
 - .2 All inserts supporting piping shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 Cast-in-place type:
 - .1 Channel type.
 - .2 Wedge type galvanized steel concrete insert, rated for the duty, for up to 200 mm pipe size.
 - .3 Universal type malleable iron body insert, rated for the duty, for up to 200 mm pipe size.
 - .4 Screw concrete insert, rated for the duty, for up to 300 mm pipe size.
 - .2 Drilled, mechanical expansion type:
 - .1 Heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa.
 - .2 Stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Drop-in anchor for concrete.
 - .4 Sleeve Anchor (medium and light duty) for concrete and masonry.
 - .5 Pin bolt (light duty) for concrete and masonry.
 - .3 Drilled, adhesive type:
 - .1 Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Anchor rod with a 2-part adhesive system.
 - .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
 - .4 Rod assemblies shall extend a minimum of 50 mm into the concrete slab below the housekeeping bases.

- .3 Note:
- .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.
 - .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

3.6 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All piping, tubing, ducts, wiring, conduits, etc. passing through rated fire separations shall be smoke and fire proofed with ULC approved materials in accordance with CAN4-S115-M85 and ASTM E814 standards and which meet the requirements of the Building code in effect. This includes new services, which pass through existing rated separations, and also all existing services, which pass through a new rated separation or existing separations whose rating has been upgraded.

3.7 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All piping, tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent the passage of smoke and/or transmission of sound. Refer to "pipe sleeve" clause in this section for packing and sealing of pipe sleeves.

3.8 PIPE SLEEVES

- .1 Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves to be concentric with pipe.
- .2 Pipes and ducts passing through fire rated separations that have no fire resistance (non-rated separations) do not require a sleeve, but the insulation at the separation should be wrapped with 0.61mm thick galvanized sheet steel band to which to apply the flexible caulking compound to.
- .3 Pipe sleeves for floors and interior walls shall be minimum 0.61mm thick galvanized sheet steel with lock seam joints.
- .4 Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 150 mm beyond sleeve diameter. Annular fin shall be embedded into centre of wall.
- .5 Pipe sleeves for wet or washdown floor areas such as washrooms, janitor's rooms and mechanical equipment rooms shall be Schedule 40 steel pipe.
- .6 Except as otherwise noted pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .7 Pipe sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.

- .8 Pipe sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.
- .9 Pipe sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.
- .10 Sleeve Size: 12 mm clearance all around, between sleeve and pipe or between sleeve and pipe insulation.
- .11 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .12 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.9 ESCUTCHEONS AND PLATES

- .1 Provide on pipes and conduits passing through finished walls, partitions, floors and ceilings.
- .2 Plates shall be stamped steel, split type, chrome plated, or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. For all pipes passing through suspended ceilings and uninsulated piping passing through walls. Outside diameter shall cover opening or sleeve.
- .3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.
- .4 Do not install escutcheons and plates in concealed locations.

3.10 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the bedplate, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .3 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise those 25 above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout.
- .4 Construct equipment supports of structural steel or steel pipe. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

- .5 Support ceiling hung equipment with rod hangers and/or structural steel.

3.11 EQUIPMENT RESTRAINTS

- .1 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 In accordance with Section 23 05 49 Seismic Restraints.

3.12 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Pipe equipment drains to floor drains. Do not create tripping hazards.
- .4 Line up equipment, rectangular cleanouts, and similar items with building walls wherever possible.

3.13 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other Divisions.

3.14 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Division 22, and 23 of the Specifications, including but not limited to:
 - .1 Support of equipment
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to piping, ductwork, hot water storage tanks, expansion tanks, fans, and mechanical equipment.
 - .3 Earthquake restraint devices - refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - .4 Access platforms, ladders, and catwalks.
 - .5 Pipe anchor and/or support posts.
 - .6 Ceiling ring bolts - secure to structure or steel supports.
- .2 All steel work shall be prime and undercoat painted ready for finish under Painting trade. Refer to drawings for details.

3.15 FLASHING

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

- .2 Flash, vent and soil pipes projecting 75 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum clear on side with minimum 600 x 600 mm sheet size. For pipes through outside walls turn flange back into wall and caulk.
- .3 Flash floor drains over finished areas with lead 250 mm clear on sides with minimum 900 x 900 mm sheet size. Fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations 400 mm minimum high above roof insulation. Flash and counterflash with galvanized steel, soldered and made waterproofed.
- .5 Provide continuous lead or neoprene safes for built-up mop sinks, and shower stalls located above finished rooms. Solder at joints, flash into floor drains and turn up 150 mm into walls or to top of curbs and caulk into joints.

3.16 DIELECTRIC COUPLINGS

- .1 On all "OPEN" systems provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2.
- .3 Provide felt or rubber gaskets to prevent dissimilar metals contact.

3.17 PAINTING

- .1 Clean exposed bare metal surfaces supplied under Division 23 removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under Division 23, which is not scheduled to be repainted, to match the original factory finish.
- .4 Natural gas and fire protection piping shall be painted for identification purposes over their entire lengths throughout all exposed areas and in the mechanical room(s) as follows:
 - .1 Gas: Yellow
- .5 Painting of all equipment and materials, supplied under Division 23, installed in mechanical equipment areas and inside finished areas of the building, or exposed outside the building, is included under Painting trade specifications.
- .6 Painting by Painting trade shall be in accordance with the following Colour Schedule for Mechanical Equipment Areas:

Item	Primer (Note **)	Colour Finish
• not galvanized	1. Damp-proof Red 2. Zinc Chromate	Grey
• galvanized	Clear blue undercoat	White (2 coats)
• plenum access doors and 200 mm around doors	Clear blue undercoat	Grey
Exposed Misc. Metal (supplied under this contract)	1. Damp-proof Red 2. Zinc Chromate	To be determined on site
Guards – Belt and Coupling	1. Damp-proof Red 2. Zinc Chromate	To match equipment
Handrails	Red Primer	Aluminum
Insulation Covering (on piping, tanks, heat exchangers, breeching, etc.)	White Primer	White
Motors (electric)		To match associated equipment
Piping (uninsulated)		
• gas (natural)	Red Primer	Yellow
• services other than above	Red Primer	White
Valve Bodies (uninsulated)		
• hot water heating, antifreeze heating	Red Primer	Aluminum (high temp.)
• services other than above	Red Primer	To match associated piping

Note ** 1. Denotes first primer coat and 2. Denotes second primer coat.

3.18 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping systems.
- .2 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.
- .3 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.
- .4 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .5 Provide, install, and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums, and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.

3.19 START-UP

- .1 Before starting the plant, provide a certificate stating that the plant is ready for start-up and the following conditions have been met.
 - .1 All safety controls installed and fully operational.
 - .2 Permanent electrical connections made to all equipment.
 - .3 All mechanical equipment rooms, vacuum cleaned.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Bases, pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Section 23 05 48 – Vibration and Seismic Controls
- .3 Section 23 05 49 – Seismic Restraints
- .4 Section 23 07 13 – Thermal Insulation for Ducting
- .5 Section 23 07 16 – Thermal Insulation for Piping

1.3 REFERENCES

- .1 Installation, workmanship and testing shall conform to the following (in cases of conflicting requirements, the most stringent shall apply):
 - .1 National Building Code of Canada NBCC-2015
 - .2 British Columbia Building Code BCBC-2018
- .2 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2007, Power Piping.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-1996 (R2007), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-14e1, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-15, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Thermal Insulation Association of Canada (TIAC)

1.4 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 MSS SP58 and ASME B31.1-18.
 - .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 conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements:
 - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events as specified Section 23 05 49 - Seismic Restraint.

1.5 SUBMITTALS

- .1 Submittals: in accordance with the Submittal Procedure requirements in Section 01 33 00 Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.
- .4 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .5 Quality Control Check Sheets
- .6 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 Closeout Submittals.

1.6 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .2 Check sheets to include the following information:
 - .1 Pipe or ductwork system
 - .2 Equipment number, make and model, including weights
 - .3 Pipe support type and spacing
 - .4 Pipe support finish (corrosion protection, painted)
 - .5 Details of pipe attachment to structure
 - .6 Hanger details at pipe insulation (where applicable and specified)
 - .7 Comments on seismic installation

Part 2 Products

2.1 GENERAL

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provide for expansion and contraction, and accommodate insulation.
- .2 Provide insulation protection saddles on all insulated piping.
- .3 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.
- .4 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.
- .5 Support from structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.
- .6 Do not suspend from metal deck.

2.2 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with two springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.3 WALL SUPPORTS

- .1 Horizontal and Vertical pipe adjacent to wall.
 - .1 Exposed pipe wall support for lateral movement restraint.
 - .2 Galvanized or other non-corrosive finish.
 - .3 Channel type support - Burndy, Canadian Strut, Cantruss or Unistrut, type support.
 - .4 Angle iron wall brackets (galvanized or other non-corrosive finish) with specified hangers.

2.4 FLOOR SUPPORTS

- .1 Horizontal pipe.
 - .1 Do not support piping from the floor unless specifically indicated.
- .2 Vertical pipe.
 - .1 Mid-point of risers between floor slabs - adjustable fabricated steel supports. Refer to Section 23 05 49 - Seismic Restraints.

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.
- .2 Submit structural calculations with shop drawings, signed and sealed by Professional Engineer certified in British Columbia.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.7 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel
- .2 Submit structural calculations with shop drawings, signed and sealed by Professional Engineer certified in British Columbia.

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:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Division 1 – General Requirements.
- .2 Section 23 05 29 – Hangers and Support for Mechanical Equipment and Piping
- .3 Section 23 05 49 – Seismic Restraints
- .4 Section 23 33 00 – Air Duct Accessories
- .5 Section 23 34 00 – HVAC Fans
- .6 Section 23 73 11 – Packaged Air Handling Units
- .7 Section 23 74 00 – Packaged Outdoor HVAC Equipment
- .8 Section 23 81 23 – Split Air Conditioning Systems

1.1 REFERENCES

- .1 Installation, workmanship and testing shall conform to the following (in cases of conflicting requirements, the most stringent shall apply):
 - .1 National Building Code of Canada NBCC-2015
 - .2 British Columbia Building Code BCBC-2018

1.3 SUBMITTALS

- .1 Provide shop drawings in accordance with the requirements in Section 01 33 00 Submittal Procedures.
 - .1 Drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada. Provide Letters of Assurance (Schedule-C).
 - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Manufacturer's Reports
- .4 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 Closeout Submittals.

Part 2 Products

2.1 GENERAL

- .1 Provide vibration isolation on all motor driven equipment with motors of 1/2 HP and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 1/2 HP, provide vibration isolation grommets at the support points.
- .2 Provide seismic restraint for all equipment including all seismic restraint related hardware (bolts and anchors) from point of attachment to equipment through to and including attachment to structure. The required anchors shall be indicated on the shop drawings and shall be clearly identified for the correct location and so as to be readily identified after installation. Provide clear instructions for their installation. Refer to Section 23 05 49 Seismic Restraints.
- .3 Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval.
- .4 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.
- .5 Isolators and restraining devices, which are factory supplied with equipment, shall meet the requirements of this section.
- .6 Provide concrete inertia bases or structural steel bases, where specified or required by equipment manufacturers, located between vibrating equipment and the vibration isolation elements, unless the equipment manufacturer certifies direct attachment capabilities.
- .7 Coordinate for the provision of housekeeping pads at least 100 mm high under all isolated equipment, or greater thickness where specified. Provide at least 300 mm clearance between drilled inserts and edge of housekeeping pads. Housekeeping pads to be tied to structure with reinforcement to meet Code seismic requirements.
- .8 For isolated equipment, design anchors, bolts, isolators, and bases to meet Code requirements. For larger isolators, where the Code requirement cannot be met by the isolator housing, provide Type 6 seismic snubbers or Type 6P where post-disaster requirement is specified.
- .9 Use ductile materials in all vibration and seismic restraint equipment.
- .10 Follow manufacturer instructions for drilled inserts (installation of anchors).

- .11 Coordinate with Section 23 33 00 Air Duct Accessories for all ductwork connections to fans or plenums.
- .12 Provide flexible connectors between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in the piping system. Meet connector manufacturer's installation specifications as well as equipment manufacturer's requirements.
- .13 Coordinate with Electrical Division 26 for the provision of a minimum 180° hanging loop of flexible conduit for all electrical connections to isolated equipment.
- .14 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the contractor.

2.2 ISOLATORS - GENERAL

- .1 Supply all the vibration isolation equipment by one approved supplier with the exception of isolators, which are factory installed and are standard equipment with the machinery. Confirm with manufacturer that these factory-installed isolators meet the seismic requirements of this specification.
- .2 Select isolators at the supplier's optimum recommended loading and do not load beyond the limit specified in the manufacturer's literature.
- .3 Design springs "iso-stiff" ($k_x/k_y = 1.0$ to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.
- .4 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out of doors or in areas where moisture may cause corrosion.

2.3 ISOLATORS – TYPE 1, PADS

- .1 Neoprene or neoprene / steel / neoprene pad isolators. Select Type 1 pads for a minimum 2.5 mm static deflection or greater. Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene hemi-grommets. Avoid over-compressing grommets. Size bolt and hemi-grommet for minimum lateral clearance. Use grommets only on light-weight equipment.

2.4 ISOLATORS – TYPE 2, RUBBER FLOOR MOUNTS

- .1 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 4mm minimum static deflection, and bolt to structure. In the case of rubber isolators, provide protection in the design of the isolator to avoid contact of the rubber element to oil in the mechanical room.

2.5 ISOLATORS – TYPE 3, SPRING FLOOR MOUNTS

- .1 Spring mounts complete with levelling devices, selected to achieve 25 mm deflection under load. Springs to incorporate a minimum 6 mm thick neoprene sound pad or cup having a 1.3 mm minimum deflection under load. Design isolator to meet specified seismic requirements.
- .2 Outdoor or moist installations: Zinc or cadmium plated springs and hardware; housings coated with rust resistant paint.
- .3 Colour code springs.

2.6 ISOLATORS – TYPE 4, HANGER MOUNTS

- .1 Spring hangers, c/w 6 mm thick neoprene cup/bushing sized for 1.3 mm minimum deflection, or neoprene hangers.
- .2 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30-degree arc without metal to metal contact.
- .3 Outdoor or moist installations: Zinc or cadmium plated springs and hardware; housings coated with rust resistant paint.

2.7 CLOSED CELL FOAM GASKETS/NEOPRENE GROMMETS – TYPE 7

- .1 20 mm thick continuous perimeter closed cell foam gasket to isolate base of package type equipment, AHU's, exhaust fans, etc. from concrete floors / roof curbs. Select width for nominal 20 kPa loading under weight of equipment and allow for 25% compression 5mm. Increase width of curb using steel shim if necessary to accommodate gasket. For light equipment such as exhaust fans, deflection should be a minimum of 1.3 mm. Contractor to check fire rating requirements specified for project.

2.8 PIPE RISER GUIDE/ANCHOR – TYPE 8

- .1 Telescoping all direction acoustical pipe anchor consisting of two concentric steel tubes separated by 12 mm thick neoprene isolation material. Hot application isolators.

2.9 FLEXIBLE CONNECTORS – TYPE 9

- .1 Twin sphere flexible connectors with floating flanges c/w control rods.

2.10 STEEL BASES

- .1 Construct structural steel bases sufficiently rigid to keep deflection and misalignment within acceptable limits as determined by the equipment manufacturer.
- .2 Use height saving brackets in all mounting locations to provide a base clearance of 35 mm.
- .3 Bases to be furnished with built-in motor slide rails. Motor location as specified/scheduled.

- .4 Steel bases supplied as integral part of equipment to be supplied meeting the above requirements.

2.11 HORIZONTAL THRUST RESTRAINT

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

Part 3 Execution

3.1 INSTALLATION

- .1 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by workers experienced in this type of work.
- .2 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm to other structures, piping, equipment, etc.
- .3 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) anchors and/or welding.
- .4 After installation and adjustment of isolators verify deflection under load to ensure loading is within specified range and isolation is being obtained.
- .5 Where hold down bolts for isolators or seismic restraint equipment penetrate roofing membranes, provide "gum cups" and sealing compound to maintain waterproof integrity of roof. Ensure sealing compound is compatible with isolator components such as neoprene. Co-ordinate with roofing section of specifications and with roofing subcontractor.
- .6 Under equipment mounted on Type 3 mounts, which do not meet the seismic requirement, provide Type 6 seismic snubbers.
- .7 Select Type 4 spring hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units, emergency generator exhaust piping and silencers, steam PRV's and any other vibrating sources.
- .8 Isolate axial fans rotating at more than 1170 RPM on type 2 isolators.
- .9 Use the lowest RPM scheduled for variable speed equipment in determining isolator deflection.
- .10 Where ductwork, piping or boiler exhaust stacks, etc., connected to or serving noise generating equipment, is routed through walls, floors, piping chases, etc. position ductwork, piping, stacks, etc. to avoid contact with

the concrete structure, future framing, drywall, and other finishes which may radiate noise. Use Type 2 and Type 8 mounts. Submit proposed details to meet this requirement. This requirement includes piping from chiller and emergency generator exhaust.

- .11 Provide Type 8 resilient elements in pipe anchors, where pipe anchors are within 12 m of a vibrating source or if located in pipe chases.
- .12 Protect neoprene isolator components from overheating or use type 8 mounts.
- .13 Be responsible for ensuring that flexible duct connections are installed with a minimum of 40 mm metal-to-metal gap. Use flanges to ensure that flexible connectors are clear of the airstream.
- .14 Isolate variable frequency drive controller using isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission. Controller supplier to provide all isolation, including wiring connections, to control flanking noise transmission. Provide isolation meeting all seismic requirements.
- .15 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.
- .16 Floor or pier mounted equipment: Isolate all floor or pier mounted equipment on Type 3 isolators, unless otherwise specified.
- .17 Slab on grade mounted equipment: For equipment mounted on a slab on grade, mount on type 2 isolators unless otherwise specified.

3.2 INSPECTIONS

- .1 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment.
- .2 The supplier shall inspect the complete installation after system startup and establish that the isolators for each piece of equipment are properly installed and adjusted. Correct any mal-performance. The supplier shall submit a statutory declaration to the Departmental Representative stating that the complete vibration isolation installation is installed in accordance with his drawings and instructions and operates to his satisfaction.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

- .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Once during the installation, at 50% completion stage.
 - .4 Upon completion of installation.
- .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Seismic restraint systems (SRS) for statically supported and vibration isolated equipment and systems; including mechanical and process equipment, mechanical and process distribution systems, fire protection, both vibration isolated and statically supported.

1.2 RELATED SECTIONS

- .1 Division 1 – General Requirements
- .2 Section 23 05 29 – Hangers and Supports for Mechanical Equipment and Piping
- .3 Section 23 05 48 – Vibration and Seismic Controls

1.3 REFERENCES

- .1 Installation, workmanship and testing shall conform to the following (in cases of conflicting requirements, the most stringent shall apply):
 - .1 National Building Code of Canada NBCC-2015
 - .2 British Columbia Building Code BCBC-2018
- .2 SMACNA – Seismic Restraint Manual – Guidelines for Mechanical Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.4 DEFINITIONS

- .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
- .2 SRS: acronym for Seismic Restraint System.

1.5 SCOPE OF WORK

- .1 Provide restraint on all piping, ductwork, equipment and machinery, which is part of the building mechanical and process systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake. This specification covers equipment, which is not specifically covered in SMACNA.
- .2 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.
- .3 When equipment is mounted on concrete housekeeping pads, and / or concrete curbs the anchor bolts shall extend through the pad into the structure.

- .4 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .5 Seismic restraints may only be omitted where permitted by SMACNA.
- .6 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia. Provide Letters of Assurance (Schedule-C).

1.6 SUBMITTALS

- .1 Submittals in accordance with the requirements in Section 01 33 00 Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.
 - .1 Note that the shop drawings must be specific to this project, with reference and drawings showing attachment to the existing or new structure.
 - .2 Seismic Engineer to visit site to survey the existing conditions, before submitting the shop drawings.
 - .3 Generic shop drawings that do not reflect the actual site conditions, will be rejected.
- .4 Submit design data including:
 - .1 Full details of design criteria.
 - .2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics, full specifications for components of each SRS to be provided.
 - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .4 Separate shop drawings for each SRS and devices for each system, equipment.
 - .5 Identification of location of devices.
 - .6 Schedules of types of SRS equipment and devices.
 - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.

- .8 Installation procedures and instructions.
- .9 Design calculations including restraint loads to NBC and Supplement.
- .10 Detailed work sheets, tables.
- .11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.
- .5 Quality assurance submittals: Submit the following in accordance with the requirements in Section 01 33 00.
 - .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 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .6 Certificate of Compliance from Contractor's Seismic Engineer (refer to Clause 3.5.1).
- .7 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 Closeout Submittals.

Part 2 Products

2.1 SRS MANUFACTURER

- .1 SRS from one manufacturer, regularly engaged in SRS production.

2.2 GENERAL

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to reinforced concrete structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.

- .7 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.
 - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Vibration isolators with built-in snubbers.
 - .2 Vibration isolators and separate snubbers.
 - .3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.
 - .2 SRS to resist complete isolator unloading.
 - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
 - .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

Part 3 Execution

3.1 GENERAL

- .1 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.
- .2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .3 The following are guidelines for some items not covered in SMACNA but certified shop drawings should still be submitted. Note that this list is not intended to cover all equipment requiring restraints.

3.2 AIR TERMINALS

- .1 Where air terminals are installed in mechanical grid ceilings, provide at least two 12 ASWG galvanized steel wire seismic security bridles per air terminal tied either to the building structure or to ceiling hanger wires.
- .2 Attach security bridles at opposite corners of each air terminal and in such a manner that the air terminal cannot fall.
- .3 Provide all necessary brackets for attachment of security bridles to the air terminals.

3.3 NON-ISOLATED FLOOR MOUNTED EQUIPMENT

- .1 Not used.

3.4 ISOLATED PIPING AND EQUIPMENT

- .1 Install cables using appropriate grommets, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.
- .2 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.
- .3 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.

- .4 On piping systems, provide transverse slack cable restraints at a maximum spacing of 10 m and longitudinal restraints at 20 m maximum spacing, or as limited by anchor/slack cable performance. For pipes greater than NPS10, reduce transverse restraint spacings to 6.0 m.
- .5 Small pipes may be rigidly tied to big pipes for restraint, but not the reverse.
- .6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within 600 mm of the elbow or T, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.
- .7 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.
- .8 At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed the transverse spacings discussed above for horizontal pipes, with guide clearance not exceeding 3 mm.
- .9 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.
- .10 Install restraints at least 50 mm clear of all other equipment and services.
- .11 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm under thumb pressure for a 1.5 m cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm.
- .12 Provide transverse and axial restraints as close as practical to a vertical bend.
- .13 At steel trusses, connect to top chords and follow truss manufacturer's instructions.
- .14 The maximum spacing between transverse and longitudinal restraints for piping and ductwork shall be 25% less than specified in SMACNA for SHL A.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and Certification:
 - .1 SRS: inspected and certified by Contractor's Seismic Engineer (who signed shop drawings) upon completion of installation.
 - .2 Provide written report to Departmental Representative with certificate of compliance.

- .2 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

3.6 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 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Division 1 – General Requirements.

1.3 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-15, Natural Gas and Propane Installation Code.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Shop drawings to indicate the following:
 - .1 Legend of proposed identification details for each system.
 - .2 Details of proposed nameplates, labels, and tags.
- .4 Samples:
 - .1 Provide a sample of a typical nameplate, label and tag for review and approval of Departmental Representative.
 - .2 Provide a mock up of each type of piping identification.
- .5 Quality Control Check Sheets.

1.5 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Submit all information and material required for the Quality Management System, in accordance with the requirements in Section 01 45 00.
 - .3 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .4 Quality Control Check Sheet:
 - .1 Prepare and maintain Quality Control Check Sheets.

- .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.
- .3 Check sheets to be filled in and submitted for review, prior to substantial completion.
- .4 Tabulated check list including the following:
 - .1 Equipment number and type
 - .2 System type
 - .3 Equipment and system location
 - .4 Identification completed
 - .5 Spacing as specified
 - .6 Placed in visible location
 - .7 Match existing identification
 - .8 Corrosion resistant nameplates, tags and ties
 - .9 Valve schedule and identification chart

Part 2 Products

2.1 GENERAL

- .1 There are areas in this project where the relative humidity levels will be high.
- .2 Select an identification system that is appropriate for such an environment.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Lamacoid nameplate, mechanically fastened to each piece of equipment by manufacturer.
- .2 Include ULC, (Underwriters' Laboratories Canada) or CSA, (Canadian Standards Association) registration logos and those of other agencies, as required by the respective agencies.
- .3 Nameplates shall be located so that they are easily read. Do not insulate or paint over nameplates.
- .4 Lettering and numbers raised or recessed.
- .5 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.

2.3 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 3mm thick laminated plastic (lamacoid), matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 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 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.
- .5 Identify all systems and areas or zones of building being serviced.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.
 - .1 Paint all natural gas piping yellow.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as

- necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3-12 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 Pipe Size
 - .1 Indicated the pipe sizes on all main pipe runs.
 - .2 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .3 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .6 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
 - .7 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 or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
 - .8 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
Natural gas	to Codes	
Gas regulator vents	to Codes	

2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

2.7 VALVES, DAMPERS, CONTROLLERS

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

2.8 CONTROLS COMPONENTS IDENTIFICATION

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

2.9 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 ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 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 mechanical rooms, equipment rooms, crawlspace: at not more than 15 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas, service spaces 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, 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 UV rated plastic tie wraps.
- .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 in logical manner. Verify with Departmental Representative prior to proceeding with final valve tag numbering. By default, the valves shall be numbered consecutively.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Testing, Adjusting and Balancing (TAB) is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for all HVAC and some specific process systems in the facility.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.
- .3 TAB specialist shall coordinate balancing efforts with the controls and commissioning contractors. If systems are placed in manual override during balancing, provide justification and reasoning.
- .4 Submit a draft TAB report prior to substantial completion.

1.2 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Section 23 08 00 – Mechanical Commissioning.
- .3 Section 23 09 93 – Controls Sequence of Operation.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Operating and Maintenance Manuals.
- .3 Qualifications of TAB Company and Personnel.
- .4 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB.
- .5 Test Reports: submit certified test reports from approved TAB Company indicating compliance with specifications for specified performance characteristics and physical properties. Include as follows:
 - .1 Pre-TAB review – confirmation of the adequacy of provisions of TAB.
 - .2 List of any standards or procedures that differ from specified standards.
 - .3 Preliminary TAB Report.
 - .4 Statutory declaration certifying that the TAB procedures have been completed.
 - .5 Fire Damper Test Report.
 - .6 Final TAB Report.

1.4 QUALIFICATIONS OF TAB COMPANY AND PERSONNEL

- .1 Testing, Adjusting and Balancing Company shall meet the following qualifications:
 - .1 Minimum of ten years of recent experience in testing and balancing of mechanical systems, for a variety of industrial processes and systems.
 - .2 The senior site technologist/technician must have a minimum of ten years TAB experience of similar industrial projects.
 - .3 Submit names of personnel to perform TAB to the Departmental Representative within 30 days of award of contract.
 - .4 Provide documentation confirming qualifications, successful experience.
 - .5 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2016.
 - .2 National Environmental Balancing Bureau (NEBB), Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2006.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing Procedural Guide, 2003.
 - .6 Use TAB Standard provisions, including checklists, and report forms; submit final report at the completion of the project. Include report in the maintenance manual.
 - .7 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
 - .8 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
 - .9 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.5 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges (simulate filter loading, outdoor air provision, etc).

1.6 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction (such as sprinkler system, fire alarm system, etc.)

1.7 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Schedule and coordinate TAB work with Commissioning work.
- .3 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems. See Section 23 09 93 Controls Sequence of Operation for systems interlocks.

1.8 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to the Departmental Representative the adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to the Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, dampers, accessories, measurement ports and fittings.

1.9 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.

1.10 START OF TAB

- .1 Notify Departmental Representative seven (7) days prior to start of TAB.

- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, and caulking.
 - .3 Pressure, leakage, other tests specified elsewhere in Division 23.
 - .4 Provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.

1.11 APPLICATION TOLERANCES

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

1.12 ACCURACY TOLERANCES

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

1.13 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative a list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 6 months of TAB. Provide certificate of calibration to Departmental Representative.

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 in accordance with SMACNA Guidelines.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 4 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index and index tabs. Provide PDF copy.
- .4 Include final TAB report in maintenance manual. Provide PDF copy.

1.16 VERIFICATION

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

1.17 SETTINGS

- .1 After TAB is completed to the satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.
- .2 Include final TAB report in the maintenance manual.

1.19 TAB GENERAL

- .1 Standard: TAB to most stringent of this section or TAB standards of SMACNA or ASHRAE.
- .2 Do TAB of following systems, equipment, components, controls:
 - .1 Supply air system(s).
 - .2 Return air system(s).
 - .3 Outdoor air system(s).
 - .4 Exhaust air system(s).
 - .5 Hydronic heating systems and pumps.
- .3 The TAB agency shall be responsible to the Contractor but report jointly to the Departmental Representative and the Contractor. Report in writing to the Departmental Representative any lack of cooperation and any discrepancies or items not installed in accordance with the contract documents.
- .4 Procedures shall be in general accordance with AABC's National Standards for Field Measurement and Instrumentation and ASHRAE Standards.
- .5 The TAB agency shall agree to perform spot checks, where requested, in the presence of the Departmental Representative.
- .6 Work with the TAB agency to:
 - .1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.
 - .2 Make corrections to achieve system balance without delay, include all corrections made during the balancing procedure on "As Built" Drawings. Mechanical Contractor to provide "As Built" information to the balancing agency before balancing commences.
 - .3 Adjust fan drives and change sheaves and belts as directed by the agency. Allow for the cost of the replacement sheaves and belts.
 - .4 Maintain all systems in full operation during the complete testing and balancing period.
 - .5 Employ control technicians to make adjustments to the control systems to facilitate the balancing process.
 - .6 Employ the journeyman millwright to check the alignment of any V-belt drives and/or shaft coupling drives if they have been adjusted during the balancing process. Belt tension correctness to be verified.

- .7 Consult with the Departmental Representative to clarify the design intent where necessary or in case there are any problems foreseen as the balancing processes.
- .8 Complete air balance before commencing water balance where heating/cooling coils are installed in the air system. Balancing shall not commence until systems have been cleaned and treated and the air removed from within the piping systems.
- .9 This TAB agency shall remove and re-install ceiling tile to provide access to ductwork and piping. The TAB agency will make good any damage or soiling caused by his forces.
- .10 Permanently mark final settings on valves, dampers, and other adjustment devices. Set and lock all memory stop balancing devices.
- .11 Seal all holes with snap plugs or approved alternate method, used for flow and pressure measurements.
- .12 The controls contractor and TAB agency are to allow for checking and making adjustments during the 12-month warranty period, when weather conditions provide natural loads and in cases where complaints arise.
- .13 Submit a draft balance report to the Departmental Representative for approval and submit approved copies to the agency preparing the O & M manuals for inclusion in each operating and maintenance manual. Provide field notes in the balancing report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment. Identify outstanding problems that cannot be corrected by the balancing team or that will not be corrected by the installing trades (e.g. in cases where additional balancing dampers are required).
- .14 Submit a statutory declaration to the Departmental Representative, certifying that the testing and balancing 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 correction of faults and omissions, has been completed and recorded. Reports to be signed by the senior member of the TAB agency.
- .15 Employ the testing and balancing agency to test all fire dampers as follows:
 - .1 Test all fire dampers. The test shall be made by releasing the fusible link and witnessing closure of the damper. All fire dampers shall be left in the open position.
 - .2 A set of prints shall be marked up to show that each damper has checked for closure, accessibility and installation or provide schematic mechanical drawing showing all fire damper locations,

label all fire dampers on drawing and reference made in the completed test certificate submitted to the Departmental Representative.

- .16 The Balancing Agency shall include for 5 (five) days of return visits for readjustment of systems after the building is occupied and used.

1.20 AIR AND WATER SYSTEMS TAB

- .1 Quality assurance: perform TAB under direction of supervisor qualified to standards of Associated Air Balance Council (AABC), National Standards for Total System Balance or National Environmental Balancing Bureau (NEBB) "Procedural Standards for Testing, Adjusting and Balancing Environmental Systems".
- .2 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .3 Systems Data – the following information shall be provided:
 - .1 Air Handling Equipment:
 - .1 Design Data:
 - .1 Total air flow rate;
 - .2 Fan total static pressure;
 - .3 System static pressure;
 - .4 Motor kW, r/min, amps, volts, phase;
 - .5 Outside air flow rate L/s;
 - .6 Fan r/min;
 - .7 Fan kW;
 - .8 Inlet and outlet, dry and wet bulb temperatures.
 - .2 Installation Date:
 - .1 Manufacturer and model;
 - .2 Size;
 - .3 Arrangement discharge class;
 - .4 Motor type, kW, r/min, voltage, phase, cycles, and load amperage;
 - .5 Location and local identification data.
 - .3 Recorded Data:
 - .1 Air flow rate;

- .2 Fan total static pressure;
 - .3 System static pressure;
 - .4 Fan r/min;
 - .5 Motor operating amperage;
 - .6 Inlet and outlet, dry and wet bulb temperatures.
- .2 Duct Air Quantities: All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum), major return air openings back to duct shafts or air handling units.
- .1 Duct sizes;
 - .2 Number of pressure readings;
 - .3 Sum of velocity measurements;
 - .4 Average velocity;
 - .5 Dust recorded air flow rate;
 - .6 Duct design air flow rate.
- .3 Air Inlet and Outlets:
- .1 Outlet identification location and designation;
 - .2 Manufacturers catalogue identification and type;
 - .3 Application factors;
 - .4 Design and recorded velocities;
 - .5 Design and recorded air flow rates;
 - .6 Deflector vane or diffuser cone settings.
- .4 Air Heating and Cooling Equipment
- .1 Design Data:
 - .1 Heat transfer rate;
 - .2 Liquid and air flow rates;
 - .3 Liquid pressure drop;
 - .4 Air static pressure drop;
 - .5 Entering and leaving liquid temperatures;
 - .6 Entering and leaving air dry and wet bulb temperatures;
 - .7 Fluid and air side pressure drops.

- .2 Installation Data:
 - .1 Manufacturers, model, type;
 - .2 Entering and leaving fluid flow and temperatures
 - .3 Entering and leaving fluid flow and temperatures
 - .4 Fluid and air side pressure drops
- .3 Recorded Data:
 - .1 Element type and identification (location and designation);
 - .2 Entering and leaving air dry and wet bulb temperatures;
 - .3 Entering and leaving water temperatures;
 - .4 Water pressure drop;
 - .5 Air static pressure drop;
 - .6 Air and water flow rates;
 - .7 Adjusted temperature rise or drop.
- .4 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
- .5 Adjust duct and terminal balance dampers, and adjust or change drive sheaves and fan blade pitch angles to obtain design quantities (within +/- 10%) at each outlet and inlet.
- .6 Use terminal balance dampers to regulate air quantities only to the extent that adjustments do not create objectional air motion or sound levels. The sheet metal sub contractor shall provide additional dampers where required by the balancing agency to achieve a satisfactory balance without creating noise problems.
- .7 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area of duct. Provide a "Pitot Tube" traverse test sheet for each major duct branch.
- .8 Measure air quantities at each air terminal.
- .9 Maintain the design relationship between the supply and exhaust air system quantities.
- .10 Check to ensure that supply and return air quantities provide reasonable building pressurization. Document abnormal building leakage conditions noted.
- .11 Adjust the air terminals to obtain the optimum air distribution pattern.

- .12 Controllers on heating coils are to be checked by the controls contractor and the commissioning agent and they shall also verify that room thermostats / sensors are cycling valves properly.
- .13 Air systems shall be balanced with clean filters in place, at a total of 105% to 110% of specified total airflow rates.
- .14 Where variable air volume systems are installed, take measurements at maximum and minimum flows. Record the minimum operating duct static pressure set-point for each air handling system.
- .15 In conjunction with the Controls Contractor set and verify the outdoor air damper minimum position. The balancing agent shall measure the O/A volume during minimum O/A condition when the air system is at a simulated minimum system condition.
- .16 Balance all air systems for 100% (or maximum) outdoor air and 100% (or maximum) relief air. Upon completion of each system balance, check to ensure that the fan motor does not overload and that the main duct pressure does not change substantially when the system is switched over to minimum O/A condition.
- .17 Include in the air balance report:
 - .1 Date of test, Name and address of building and balancing technician's name.
 - .2 Range of outdoor air temperature during the balancing period.
 - .3 System schematics indicating damper positions, design and measured air quantities at each inlet and outlet. Show room numbers, and thermostat locations.
 - .4 If installation permits, record both air terminals and fan discharge traverse air volumes to establish system leakage.
 - .5 Main branch duct traverses. Maximum and minimum outdoor air quantities.
 - .6 Static pressure across each component in an air handling system at full flow.
 - .7 Face velocities across major components such as filter or coils.
 - .8 Static pressure across each fan.
 - .9 System static pressures at selected points throughout the supply duct system and in main branch ducts in low velocity systems.
 - .10 Fan and motor speed.
 - .11 Motor size, starting time, amps and voltage.
 - .12 Coil air entering and leaving temperatures (D.B. and W.B.).

- .13 Maximum and minimum zone supply air temperatures under prevailing conditions at time of test.
- .14 Provide fan performance curve for each new air handling system.
- .15 Pressure differences between "refuge areas" and adjacent spaces.

1.21 POST-OCCUPANCY TAB

- .1 Participate in systems checks twice during Warranty Period
 - .1 First visit at approximately 3 months after substantial completion,
 - .2 Second visit within 2 months of termination of Warranty Period.
- .2 Include for three days on site for checking and system balance modifications during each visit.
- .3 Provide updated TAB report after each visit, summarizing any adjustments changes made.

Part 2 Products

2.1 DOCUMENTATION

- .1 Provide draft report, final report, warranty report.

Part 3 Execution

3.1 NOT USED

END OF SECTION

1 MECHANICAL FORMS

1.1 MF 100 Check List – Submissions to Departmental Representative

ITEM	CHECKED BY	DATE
10 DAYS AFTER AWARD OF THE CONTRACT – List of equipment suppliers and subtrades		
A.S.A.P. – Product & Fabrication samples (MF 131) – Shop Drawings		
PRIOR TO CLOSING IN CEILINGS & SHAFTS – Duct and pipe test data – Piping Test Data (MF 141)		
PRIOR TO STARTING SYSTEMS – Checklists for start-up (MF 151, 152, 153)		
PRIOR TO COMMISSIONING SYSTEMS – Checklists for operation (MF 151, 152, 153) – Commissioning schedule		
PRIOR TO DEMONSTRATION OF SYSTEMS – Demonstration agenda		
10 DAYS PRIOR TO SUBSTANTIAL PERFORMANCE INSPECTION – Submission of items listed on Form MF-188		
WHEN REQUESTING INSPECTION OF OUTSTANDING WORK – Checklist of work remaining (MF 191) – Checklists of Demonstrations (MF 181, 182) – Certificate of total completion (MF 192)		

1.3 MF 151 Check List - Start-up and Operation Requirements - Air Systems

System: _____

ITEM	CHECKED BY	DATE
<p><u>Prior To Start-Up</u> Safety Controls Installed & Operational Control and Smoke Dampers Operational Permanent Electrical Connections Made Fan Drives Aligned By Millwright Fan Rooms & Plenums Vacuum Cleaned Equipment Lubricated Building Swept & Clear Of Dust All Filters Installed Operating & Maintenance Data Available</p>		
<p><u>During Start-Up</u> Qualified Operator in Charge Supply Ducts Blown Out Using Fans R.A. & Exhaust Ducts Blown Out Using Fans</p>		
<p><u>During Subsequent Operation</u> Qualified Operator in Charge Ensure That The Building Has Remained Clean Equipment Maintained Lubrication Maintained & Logged</p>		

NOTES:

- .1 This is a brief checklist and does not cover all procedures, which may be advisable in a particular case. Additional information is available from equipment suppliers.
- .2 Prior to starting or operating each system complete the appropriate section of this form and submit it to the Departmental Representative.
- .3 Submit completed copies of this form for each system with the certificate of substantial performance.

1.4 MF 170 Certificate of Testing and Balancing

I hereby declare that I _____

I am an employee/a principal of _____

And certify that the testing and balancing procedures specified under Division 23 have been satisfactorily completed and I hereby certify that complete factual reports have been distributed.

SIGNED _____ DATE _____

NOTES:

.1 This certificate must be submitted prior to substantial performance.

1.5 MF 171 Certificate of Duct Cleanliness

I hereby certify that I _____

I am an employee/a principal of _____

And have personally witnessed that the following duct systems have been vacuumed as necessary, are now clean and have been resealed with access panels in place at all cleaning openings in the ductwork.

<u>FAN NO.</u>	<u>SYSTEM DESCRIPTION</u>
----------------	---------------------------

SIGNED _____

DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

1.6 MF 172 Certificate of Fire Damper Inspection

I hereby certify that I _____
am an employee/a principal of _____

And that all fire dampers have been tested by removing the fusible link and witnessing closure of the damper.

SIGNED _____ DATE _____

- Contract drawings supplied by: _____
- Latest addendum number or date of plans used: _____

NOTES:

1. This certificate must be submitted prior to substantial performance.

1.7 MF 173 Certificate of Penetrations Through Separations

I hereby certify that I _____
am an employee of _____

And have personally witnessed that all mechanical (HVAC & Plumbing) service penetrations through fire separations (rated & non-rated) and sound separations in the following areas have been properly sealed in accordance with the specified requirements.

AREA	SIGNED	DATE

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

1.8 MF 174 Certificate of Seismic Restraint Installation

I hereby declare that I _____
am an employee/a principal of _____

And certify that the seismic restraint of all mechanical equipment, piping and ductwork specified under Division 23 has been satisfactorily completed and that the installation meets the requirements of the B.C. Building Code as it relates to seismic restraint.

SIGNED _____ DATE _____

NOTES:

.1 This certificate must be submitted prior to substantial performance.

1.9 MF 175 Certificate of Vibration Isolation

I hereby declare that I _____
am an employee/a principal of _____

And certify that the vibration isolation installation specified under Division 23 has been satisfactorily completed.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

1.10 MF 180 Check List & Record – Items to be Handed to Departmental Representative

ITEM	RECEIVED	DATE
Control Drawings (Framed/Plasticized)		
Fan Belts – Spare Sets		
Filters - Spare Sets		
Identification Schedule (Framed)		
Maintenance Program (Schedules & Cards)		
Master Key for B.A.S. Field Panels		
Salvaged Materials (Attach List)		
Thermostat Keys		
Valve List (Framed)		

NOTES:

- .1 Copies of this form to be submitted to the Departmental Representative with all items signed off prior to substantial performance.

1.11 MF 181 Check List – Demonstration of Air Handling Systems

System: _____

ITEM	CONTRACTOR		DEPARTMENTAL REPRESENTATIVE	
	SIGNED	DATE	SIGNED	DATE
Review of System Concept				
Review of Maintenance Manual				
Review of System Balance				
Troubleshooting				
Points of required Maintenance				
Access to Equipment				
Location of Control Devices				
All Electric Interlocks				
All Alarms				
Temperature Control				
Humidity Control				
Air Pressure Control				
Air Volume Control				

NOTES:

- .1 Contractor to submit copies of this form with each appropriate item signed and dated by the person having overall charge of commissioning prior to substantial performance. (See MF 190).
- .2 Departmental Representative to sign off each item during the demonstration.
- .3 Contractor to strike out items where they do not apply to the systems being demonstrated.
- .4 Interlocks and controls to be demonstrated by following the descriptions and diagrams in the contract documents and proving that all controls function as required.
- .5 Where multiple identical controls are installed (thermostats) the Departmental Representative may elect to only witness sample items, but the person having charge of commissioning is expected to have checked all of them.

1.12 MF 188 Check List – Substantial Completion Submissions - HVAC

SECTION	ITEM	CHECKED
23 05 00	Gas Inspection Certificate	
23 05 00	Equipment Extended Warranties Certificates	
23 05 00	Lubrication of Equipment Checklist	
23 05 00	Penetrations through Separations Certificate (MF-173)	
23 05 93	Air and Liquid Balancing Report	
23 06 02	Testing & Balancing Certificate (MF 170)	
23 06 02	Fire Damper Inspection Certificate (MF 172) and Checked Drawings	
23 08 00	Commissioning Report and Checklists	
23 05 00	Operating & Maintenance Manuals	
23 05 00	Record Drawings	
23 05 00	Maintenance Program	
23 05 00	Demonstration to Operating Staff agenda	
23 05 54	Identification Schedules	
23 06 02	Vibration Isolation Installation Certificate (MF-175)	
23 06 02	Seismic Restraint Installation Certificate (MF-174)	
23 31 00	Duct Leakage Test Reports	
23 31 00	Duct Cleanliness Certificate (MF 171)	
23 06 02	Demonstrations Checklists (MF 181, 182)	
23 06 02	Items handed to Departmental Representative Checklist (MF 180)	
23 06 02	Substantial Performance Certificate (MF 190)	
23 06 02	Checklist of work remaining after Substantial (MF 191).	

NOTES:

- .1 This list is provided as a checklist and may not include all substantial completion requirements.

1.13 MF 190 Certificate of Substantial Performance Division 23

I hereby certify that I _____

am an employee / a principal /an agent

of _____

and have personally witnessed the following with regard to the mechanical systems work specified on the above project and that to the best of my knowledge except as noted on MF 191 (attached);

- The installation is complete and as specified.
- The systems have been commissioned and operate satisfactorily.
- Every control sequence and every control performs as specified.
- The systems are clean.
- All of the required submissions have been made to the Departmental Representative.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be completed and submitted to the Departmental Representative prior to substantial performance.
- .2 If it is apparent during this inspection that the systems or their operation are seriously deficient then all reasonable costs of any subsequent inspections shall be deducted from the contract sum.

1.14 MF 191 Check List – Work Remaining After Substantial Performance

		COMPLETION		
ITEM NO.	DESCRIPTION	CLAIMED BY	DATE	VERIFIED DATE

NOTES:

- .1 This form must be filled in and submitted to the Departmental Representative prior to substantial performance.
- .2 Items arising out of this inspection will be added to the list by the Departmental Representative. Copies of the complete list will be circulated to the Departmental Representative and the Prime Contractor.
- .3 The Contractor may include estimated values against the outstanding work but determination of the actual amounts to be held will be made by the Departmental Representative.
- .4 The Contractor shall sign off each item as it is completed and submit the list monthly to the Departmental Representative. When all items are signed off the completed list shall be submitted with the certificate of total performance MF-192.

1.15 MF 192 Certificate of Total Performance – Division 23

I hereby certify that I _____
am an employee / a principal / an agent

of _____

and have personally witnessed that each item of outstanding work on the checklist and record of work remaining after substantial completion MF 191 (attached) has been satisfactorily completed and I hereby certify that the Mechanical systems work specified on the above project is complete.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be completed and submitted to the Departmental Representative prior to substantial performance.
- .2 If it is apparent during this inspection that the systems or their operation are seriously deficient then all reasonable costs of any subsequent inspections shall be deducted from the contract sum.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED:

- .1 Provide external thermal insulation for plenums and ductwork as called for.
- .2 Provide internal acoustical insulation for plenums and ductwork, as called for.
- .3 Journeyman insulation applicators, skilled in this trade, shall perform the work.
- .4 Be responsible for ensuring that sufficient space is always provided to allow proper installation of insulation materials.
- .5 As applicable, use the latest edition of the "B.C. Insulation Contractors Association (BCICA) Standards Manual" as a reference standard if sufficient detail/information is not specified herein.

1.2 REGULATORY REQUIREMENTS

- .1 Flame spread ratings and smoke developed classifications shall be as required by the most recent B.C. Building Code and NFPA 90A-18. Generally, the flame spread rating throughout the material shall not exceed 25 and the smoke developed classification shall not exceed 50.
- .2 Insulation thickness and insulating values shall be in accordance with ASHRAE 90.1-19.

1.3 QUALIFICATIONS AND SAMPLES

- .1 Submit, for approval, substantiating manufacturer's documentation (and samples when requested) for all materials, applications and finishing methods to establish that all will satisfy this specification and meet all applicable code requirements, before commencing work.

Part 2 Submittals and Shop Drawings

- .1 In accordance with Section 01 33 00 Submittal Procedures.

Part 3 Products

3.1 EXTERNAL FLEXIBLE INSULATION

- .1 External flexible glass fibre insulation with integral vapour barrier.
 - .1 Minimum density - 12 kg/cu.m.
 - .2 Thermal Conductivity at 24 deg.C. - 0.042 W/m/deg.C.

3.2 DUCT LINER

- .1 Rigid Acoustic Duct Liner
 - .1 Yellow or light coloured internal rigid glass fibre acoustical insulation with black sealer coating on one face.

- .2 Minimum sound absorption (NRC) of 0.60 as tested per ASTM C423-17 using type "A" mounting.
- .3 Thermal Conductivity at 24 deg.C. - 0.035 W/m/deg.C.
- .2 Flexible Acoustic Duct Liner
 - .1 Yellow or light coloured internal flexible glass fibre acoustical insulation with one face faced with non-woven fiberglass mat.
 - .2 Minimum sound absorption (NRC) of 0.60 as tested per ASTM C423-17 using type "A" mounting.
 - .3 Thermal Conductivity at 24 deg.C. - 0.040 W/m/deg.C.

3.3 ACCESSORIES

- .1 Insulation Adhesive
- .2 Vapour Barrier Tape
 - .1 Finishing tape as commercially available to meet flame spread rating and smoke developed classification requirements of NBCC 2015 and compatible with facing material.
 - .2 Scrim foil self-adhesive tape.
- .3 Vapour Barrier Adhesive
- .4 Insulation Coating
- .5 Weather Coating - vapour barrier
- .6 Reinforcing Membrane
 - .1 Glass reinforcing membrane as commercially available.
- .7 Seal Coating
- .8 Fabric Adhesive
- .9 Fabric Coating

3.4 SCOPE OF INSULATION

- .1 Scope 1: External Flexible Insulation with vapour barrier. (Exposed ducts within a room, which is being served by the exposed ducts, do not require external insulation)".

	Thickness
Service	Mm
All cooling and heating supply ducts; - where the temperature difference between the space within which the duct is located and the design air temperature in the duct, is <u>less than or equal to 22.2°C [40°F]</u>	40

	Thickness
Service	Mm
All cooling and heating supply ducts; - where the temperature difference between the space within which the duct is located and the design air temperature in the duct, is <u>greater than</u> 22.2°C [40°F].	50
Combustion intake / relief air	50
Exhaust air discharge through roof (including sides and bottom of plenum).	50
Exhaust air ductwork outside the building.	25
All exhaust air ductwork from outside wall or roof to 1.5 m [5 ft.] inside building.	25

.2 Scope 2: Internal Flexible Acoustic Duct Liner

	Thickness
Service	mm
All ductwork where indicated by cross hatching	as indicated on drawings
All exposed supply ductwork in the mechanical room (from A.H.U. discharge to duct shaft)	50

.3 Scope 3: Internal Rigid Acoustic Duct Liner

	Thickness
Service	mm
Cold and hot supply air plenums. Line walls, tops and bottoms from discharge dampers to supply duct connections.	50
Supply and Return air plenums within 3 meters of AHU connections.	50

Part 4 Execution

4.1 APPLICATION

- .1 Apply external insulation to ductwork only after all tests have been made and systems accepted by the Departmental Representative as airtight.
- .2 Apply insulation and insulation finish in a workmanlike manner so that the finished product is uniform, smooth in finish, pleasing to the eye and with longitudinal seams concealed from view. Apply ductwork insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
- .3 Insulation and vapour barrier shall be continuous through all non-rated separations.

4.2 INSULATION TERMINATION

- .1 Terminate insulation short of all control, smoke and fire dampers so as not to interfere with their operation.
- .2 Terminate insulation 900 mm short of duct mounted electric heating coils.

4.3 EXTERNAL FLEXIBLE INSULATION WITH VAPOUR BARRIER

- .1 Adhere insulation with insulation adhesive applied in 150 mm wide strips on 300 mm centres.
- .2 On rectangular ductwork and plenums, over 610mm in width, spotweld pins 6mm longer than the insulation thickness, one per square foot of duct minimum. If pins are installed in the field, a capacitor gun shall be used. Impale the insulation over the pins, and hold in place using metal or nylon clips (washers). Alternatively, use an assembly consisting of a welded pin with integral head washer welded in place over the insulation. (Clinched pins not acceptable).
- .3 Adhere foil faced vapour barrier tape over all butt joints, raw edges, holding washers and other points of penetration of the vapour barrier jacket on all exposed hot and cold ducts and concealed cold ducts.

4.4 INTERNAL FLEXIBLE DUCT LINER APPLICATION

- .1 Adhere insulation with insulation adhesive applied to the whole of the metal surface, with the coating side of insulation exposed to the airstream.
- .2 Ducts 610 mm in width and less require no further adhesion.
- .3 Ducts sides and plenum panels greater than 610 mm in width shall also have metal clips or nylon pins adhered to the metal surface at 300 mm to supplement the adhesive. (Welding pins may be used provided a capacitor type gun is used.) Impale insulation or the pins or clips, with the coated side of the insulation exposed to the airstream and secured with

holding washers. Cover holding washers with reinforcing membrane and insulation coating / sealer.

- .4 Seal all transverse joints, raw edges, and other points of penetration of the coating with reinforcing membrane and insulation coating/sealer.
- .5 Seal all longitudinal joints with insulation coating sealer.
- .6 No raw edges of internal insulation material shall be exposed to the moving airstream.
- .7 NOTE: duct size shown is dimension inside the insulation. Metal duct sizes shall be increased to allow for the internal acoustic insulation thickness.

4.5 DUCTWORK INSULATION FINISHES

- .1 "Concealed" ductwork insulation, in horizontal and vertical service spaces, will require no further finish.
- .2 "Exposed" ductwork insulation "inside" finished floor spaces, mechanical/boiler or electrical rooms shall be finished with two coats of white, foil-finishing, insulation coating.
- .3 "Exposed" ductwork insulation "outside" the building shall have a weatherproof finish. Apply one coat of Childers Vi-cryl CP10, or other approved, asphaltic emulsion mastic, at the rate of 1 litre per square metre. Immediately embed #10 glass fabric into the wet coating. Smooth out all wrinkles, lapping ends and edges at least 50 mm. After the first coating has achieved initial set, but while still damp, apply a top finish coating of the asphalt emulsion mastic at 2 litres per square metre ensuring that the reinforcing glass fabric is completely coated. Smooth to a uniformly even finish.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of thermal insulation for HVAC piping.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal
- .3 Section 07 84 00 – Fire stopping
- .4 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M-14, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335/C335M-17, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C411-19, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-19, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-13(2019), Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-14(2019), Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

1.5 SUBMITTALS AND SHOP DRAWINGS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit following shop drawing information:
 - .1 Pipe insulation: manufacturer's catalogue literature
 - .2 Installation requirements
 - .3 Schedule of all piping systems and proposed insulation types, thicknesses, and finishes.

1.6 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 In accordance with Section 01 01 50 General Instructions (CSC).
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Protect from weather and construction traffic.
- .4 Protect against damage from any source.
- .5 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2

Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102-10.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702-14 or ASTM C547-19.
 - .2 Maximum "k" factor: to CAN/ULC-S702-14.

2.1 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.

2.2 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying on mineral wool, to ASTM C449/C449M.

2.3 VAPOUR RETARDER LAP ADHESIVE

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

2.4 INDOOR VAPOUR RETARDER FINISH

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

2.5 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.6 JACKETS

- .1 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.

- .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
- .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
- .6 Metal jacket banding and mechanical seals: Stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .2 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type to CAN/CGSB-51.53-95 with pre-formed shapes as required.
 - .2 Colours: white to match existing, verify with Departmental Representative prior to installation.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Minimum Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

2.7 FIRE STOPPING AND SMOKE SEAL MATERIALS

- .1 In accordance with Section 07 84 00 Fire Stopping.
- .2 References:
 - .1 CAN4-S115-M-18, Standard Method of Fire Tests of Firestop Systems.
 - .2 ASTM E814-13a(2017) Standard Method of Fire Tests and Through-Penetration Firestops.
 - .3 1997 Certifications Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
 - .4 Underwriters Laboratories of Canada. Listing of Equipment and Materials Vol. 3 Fire Resistance Ratings -Revision 4/95.
- .3 Work Included:
 - .1 Furnish all labour, material, equipment and services necessary to supply and install firestopping and smoke seals around mechanical service piping and duct penetrations through fire rated wall and floor assemblies, as indicated and as specified.

- .4 Quality Assurance:
 - .1 The work of this section shall be carried out only by an approved specialist firm, employing skilled tradesmen experienced in firestopping and smoke seal application and approved, licensed and supervised by the manufacturer of fire stopping materials.
 - .2 All work to be of the highest quality according to best trade practice and in strict accordance with manufacturer's printed specifications.
- .5 Submittals:
 - .1 In accordance with Section 01 33 00 Submittal Procedures.
 - .2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings, and method of installation.
 - .3 Submit manufacturers' product data for materials and prefabricated devices. Include assembly/location design system number references with copies of test information. Construction details should accurately reflect actual job conditions.
 - .4 For building assemblies which do not correspond to any previously tested and rated assemblies, submit proposals based on related designs using accepted fireproofing design criteria.
- .6 Materials:
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke, and gases in compliance with requirements of ULC CAN4-S115-18 and not to exceed opening sizes for which they are intended.
 - .2 Service penetration assemblies and design numbers: Certified by ULC in accordance with CAN4-S115-18 and listed in ULC Guide No. 40 U19. 1997 Certification Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
 - .3 Service penetration firestop components: Certified by ULC in accordance with CAN4-S115-18 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC or equivalent approved tests by Warnock Hersey.
 - .4 Fire resistance rating of installed fire stopping assembly shall be not less than the fire resistance rating of surrounding floor and wall assembly.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of piping systems to be complete, witnessed and certified.

- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.1 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: [A-1].
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code [1501-H].
- .3 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC code	Insulation thickness (mm)				
			Up to 25	32 -50	65-100	125-150	
Pipe sizes (NPS)							
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	
Hot Water Heating	up to 59	[A-1]	25	25	25	25	

- .4 Finishes:
 - .1 Exposed indoors: PVC
 - .2 Exposed in mechanical rooms: PVC
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .5 Outdoors: Water-proof aluminum jacket.
 - .6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.2 **INSULATION PACKING OF PIPE SLEEVES**

- .1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation - Thermal Ceramics to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

END OF SECTION

1 GENERAL

1.1 Related Sections

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Division 01 – General Requirements.
- .3 Section 23 05 00 – Common Work Results for HVAC.
- .4 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- .5 Section 23 09 93 – Controls Sequence of Operation.
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.2 Quality Assurance

- .1 CSA Standard Z320 -2011(R2016) Building Commissioning.
- .2 ASHRAE Standard 202-2018 Commissioning Process for Buildings and Systems.
- .3 ASHRAE Guideline 1.1-2007 HVAC&R Technical Requirements for the Commissioning Process.

1.3 General

- .1 Be responsible for the performance and commissioning of all equipment supplied under the sections of Division 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.
- .2 In consultation with the Commissioning Manager (Prime Contractor), ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems. Coordinate mechanical commissioning activities with the Cx Manager to avoid redundancies and inefficiencies. The mechanical commissioning agent shall report to the Cx Manager and assist the Cx Manager with mechanical commissioning activities as they directly relate to the Cx Manager activities noted in Division 01 sections.
- .3 See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.
- .4 Provide a draft commissioning report for review, and final commissioning report after review comments are received.

1.4 Submittals

- .1 In accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit commissioning plan, and commissioning reports.

1.5 Commissioning and Demonstration

- .1 Provide the services of an approved independent specialist firm (commissioning agent) to coordinate the commissioning process specified under this division and those items of other Divisions which interact with work of this Division as outlined herein, including the complete life safety and fire protection system that are affected by this renovation.
- .2 The cooperation of all trades and the project team is essential for an efficient and planned process. A team comprising the following is recommended:
 - .1 Departmental Representative
 - .2 Commissioning Authority
 - .3 Prime Contractor's Commissioning Manager
 - .4 Division 23 Mechanical Trades (including Controls)
 - .5 Division 26 Electrical Trades
- .3 Prepare a commissioning statement for each of the four [4] phases that the process is perceived to be worked through. In sequence, the phases are expected to be:
 - .1 PHASE 1 - System readiness.
 - .2 PHASE 2 - System start-up, testing, balancing etc.
 - .3 PHASE 3 - Verification of system performance.
 - .4 PHASE 4 - Demonstration & instruction.
- .4 Each phase is applicable to each major and/or separate system making up the work in Division 23 plus Division 26 interface as applicable.
- .5 Regular meetings shall be held during the commissioning process. Minutes of the meetings shall be issued to all contractors involved, the Commissioning Authority, and the Departmental Representative. Meeting times shall be coordinated with the Cx Manager.
- .6 Plan the work to be specific in respect of personnel, schedule, review and factory tests.
 - .1 Personnel: Assign direct overall charge of commissioning to a person (the commissioning agent) fully qualified through practical experience and a comprehensive knowledge of the interactive nature of building systems and their controls to understand the complete system and be available to carry the project through to total completion. This person shall be responsible for: Commissioning, Demonstration to the Commissioning Authority and Departmental Representative and issuing certificates of Substantial and Total Performance.

- .2 Schedule: Submit a schedule, as part of the construction schedules, 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 performance.
 - .3 Timing of the various phases of the commissioning, testing, balancing, and demonstration process.
- .3 Review: Within [2] weeks of commencing with the project work, the person having direct overall charge of mechanical Cx shall review design intent and intended commissioning procedures with the Cx Manager, Cx Authority and Departmental Representative. Six [6] weeks prior to the date of scheduled substantial performance, submit a detailed plan that addresses the entire approach to the commissioning process. The plan should be prepared specifically for the project at hand. The plan should include the following components:
 - .1 Name and qualifications of the commissioning agent.
 - .2 Itemized check lists for the readiness, start-up and operational verification of all equipment and systems.
 - .3 Outline of proposed method of notification and correction of interim operational deficiencies.
 - .4 Outline of proposed demonstration and operator training program.
- .4 Troubleshooting: Where problems become apparent during the commissioning process, work at the identification and resolution of these problems. The basic functions in trouble shooting are:
 - .1 What - Identification and definition of the problem.
 - .2 Why - Determination and evaluation of the causes.
 - .3 When - Determine the time available to resolve the problem.
 - .4 Involve the Cx Authority and Departmental Representative in the review of the problem and proposed resolution.
 - .5 Co-ordinate remedial action with the appropriate parties.
 - .6 Evaluate the effectiveness of the remedial action.
- .5 Laboratory (Factory) Tests: If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Cx Authority. In the event that equipment does not meet specifications, be responsible for the costs of:

- .1 The above laboratory tests, and
 - .2 All subsequent testing and correction required.
- .7 The work included in each of the four phases shall be generally as follows:
- .1 PHASE 1 System readiness
 - .1 Before starting any of the separate systems, provide a certificate stating that the specific system is ready for start-up and the following conditions have been met (see also Section 23 06 02).
 - .1 All safety controls installed and fully operational (dry run test).
 - .2 Qualified personnel available to operate the plant.
 - .3 Permanent electrical connections made to all equipment.
 - .2 System readiness shall include, but not necessarily be limited to the following:
 - .1 Checking system physical completion, including all instrumentation.
 - .2 Equipment lubrication and prestart checks.
 - .3 Rotational checks.
 - .4 Filter systems installed and sealed in place.
 - .5 Adjusting vibration isolation and seismic restraints.
 - .6 Alignment of drives (direct and belt).
 - .7 Control function checks, including all alarms.
 - .8 Self-diagnostic packaged control items checked.
 - .9 All deficiencies to be recorded, reviewed by the commissioning team, and, subsequently, corrected before proceeding to PHASE 2.
 - .2 PHASE 2 System start-up, testing, balancing
 - .1 System commissioning shall include, but not necessarily be limited to:
 - .1 Activation of all equipment and systems.
 - .2 Testing and adjustment of all equipment and systems.
 - .3 All deficiencies are to be recorded, reviewed by the commissioning team and, subsequently, corrected. The process at the point of the deficiency, shall be repeated before proceeding to PHASE 3.

- .2 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:
 - .1 Balancing of the air and liquid systems as specified in this section.
 - .2 Set up all automatic control valves/dampers and automatic temperature control devices.
 - .3 Plug all air pressure and flow measuring holes.
 - .4 Adjust vibration isolators and earthquake restraints as necessary.
 - .5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations.
 - .6 Verification of water tightness of all roof and exterior wall penetrations.
 - .7 Verification that all drain connections do not leak and are sloped.
 - .8 Testing and debugging of B.M.S. (Building Management System).
 - .9 Set up and test all alarm protective devices.
 - .10 Calibration and adjustment of the smoke venting and pressurization systems.
 - .11 Power failure test with emergency generator start-up.
- .3 Fine Tuning
 - .1 Setting up automatic controls for accurate response and precise sequencing.
 - .2 Correction of problems revealed by Balance Agency and change of motor speed and pitch as necessary.
- .4 Testing
 - .1 A detailed check by a person having direct overall charge of commissioning. This check to include all items and functions to be later demonstrated to the Commissioning Authority, Departmental Representative.

- .3 PHASE 3 Verification of System Performance
 - .1 Verification of system performance by the Commissioning Authority will not commence until PHASE 2 has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:
 - .1 The ease of access that has been provided throughout for servicing coils, motors, drives, fusible fire damper links, control and smoke dampers and damper operators.
 - .2 Location of and opening and closing of all access panels.
 - .3 Operability of randomly selected fire dampers.
 - .4 Operation of all equipment and systems, under each mode of operation.
 - .5 B.M.S. control features.
 - .6 Automatic controls.
 - .7 VFD Operation
 - .8 Rooftop AHUs and associated gas fuel systems.
 - .9 Supply and Exhaust Fans
 - .10 Hydronic Systems
 - .2 At the completion of Phase 3, the Contractor shall submit the following to the Commissioning Authority:
 - .1 A letter certifying that all work specified under this contract is complete, clean, and operational in accordance with the specification and drawings.
 - .2 A commissioning report which should include completed copies of all Phase 2 documentation outlined in the commissioning plan plus copies of start-up reports from specialty contractors and vendors and any other relevant information for inclusion in the operating & maintenance manuals.
 - .3 B.C. Gas Inspection Dept. approval of AHU on gas firing.
 - .4 Record drawings as specified, update to include changes resulting from commissioning.
 - .5 A statement confirming completion of B.M.S. acceptance test, Section 23 09 01.

- .4 PHASE 4 Demonstration and Acceptance
 - .1 Demonstration and acceptance shall not commence until the commissioning process PHASE 3 has been successfully completed.
 - .2 The Demonstration process is a planned process requiring a preplan approval before commencement and a signed statement of satisfaction from the Departmental Representative upon completion.
 - .3 For Demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Section 23 09 01 (Controls General).
- .5 Post Substantial Performance Visits
 - .1 Provide two follow-up visits to the site after substantial performance for a minimum period of three days each, to ensure that the systems are operating correctly and that they are being operated and maintained properly. Site visits shall coincide with peak winter and summer periods.
 - .2 Submit a report to the Commissioning Authority and Departmental Representative which documents any problems that have arisen and correction action required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 23 05 00 – Common Work Results for HVAC.
- .2 Section 23 09 01 – Control Devices and Instrumentation.
- .3 Section 23 09 93 – Controls Sequences of Operations.
- .4 Section 23 09 94 – Controls Points List for HVAC.
- .5 Section 26 05 00 – Common Work Results for Electrical.
- .6 Section 26 05 21 – Wiring and Cables (0-1000V).

1.2 SCOPE OF WORK

- .1 The new HVAC equipment shall be provided with their manufacturer's stand-alone controls where noted. However, all points as listed in Section 23 09 94 – Points List for HVAC Controls, as well as all points referenced in Section 23 09 93 – Controls Sequences shall be made available to the existing Building Automation System.
- .2 Controls contractor shall be responsible to perform all additions, updates, modifications, and demolition to the existing BAS system, including all logic, loops, and the graphic user interfaces to reflect the new equipment and perform the control sequences.
- .3 The existing pneumatic controls shall be demolished and replaced with new electric DDC components, the graphics updated, and sequence of operation program updated.
- .4 The contractor shall coordinate with the maintaining agency to ensure the proper integration of the new controllers and control points, as well as to upgrade or make additions to the Graphics User Interface (GUI) at the existing frontend Operator Work Stations.

1.3 GENERAL

- .1 The control system is to be fully microprocessor based.
- .2 The controls system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the H.V.A.C. systems to perform properly in the manner described and as hereinafter specified.
- .3 The controls contractor shall furnish all materials, including all central computer hardware and software, operator input/output peripherals, standalone DDC panels, automation sensors and controls, wiring. The controls contractor shall be responsible for the design, installation, supervision and labour services, calibration, all software programming, and checkout necessary for a complete and fully operational Building Automation System.

- .4 The control system is to be set up and adjusted to achieve optimum operation of the H.V.A.C. system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will not be considered as extra to the Contract. These modifications to continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of the mechanical system.
- .5 This Section is a performance specification clarified in certain sections to establish minimum standard of equipment, installation or level of control. The specification describes the basic functions required but not all of the installation details or components. This Trade is expected to have sufficient experience to be able to design and estimate the cost of an appropriate control system. Materials and work necessary to achieve a satisfactory result will not be considered extra to the contract.
- .6 The contractor shall review all contract documents and visit the site if possible, prior to the closing date of the tender and site confirm the requirements regarding the routing of interconnecting transmission network, etc.
- .7 When preparing shop drawings, review the proposed sequences, suggest improvements and review these with the Departmental Representative.
- .8 Work with the other parties involved in commissioning, assess how the programming can be modified to improve function, review this with the Departmental Representative and modify the programming as instructed by the Departmental Representative.
- .9 The control system shall be a modular, flexible and fully commissioned Direct Digital Control (DDC) System.
- .10 Items identified in the sequence of operation as being under DDC (control) but which are not included in the points list shall be included in the DDC system.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Shop drawings shall include:
 - .1 Control centre layouts.
 - .2 Manufacturer's descriptive technical literature for all equipment and devices.
 - .3 Interconnection schematics.
 - .4 Wiring and piping diagrams.
 - .5 One-line diagram from sensor and control points to Field Interface

device and/or standalone DDC panel including all components and cables.

- .6 Terminal cabinets, including termination listing.
- .7 Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission. Sequences should reference English descriptors and labels for each point described.
- .8 All input/output points which shall include the following information associated with each point.
 - .1 Sensing element type and location.
 - .2 Details of associated field wiring schematics and schedules.
 - .3 Software and programming details.
- .9 Detailed block diagrams of transmission trunk routing and configuration.
- .10 Valve and damper schedules indicating size, configuration, capacity and locations. If size varies greater than 10%, obtain approval of Departmental Representative.
- .11 Copies of all system graphics complete with system specific point labels.

1.5 **WARRANTY**

- .1 Refer to General Conditions.
- .2 The system including all hardware and software components shall be warranted for a period of one year following the date of final acceptance. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Departmental Representative.
- .3 All applicable software as detailed in this specification shall be updated by the Controls Contractor free of charge during the warranty period. This will ensure that all system software will be the most up-to-date software available from the Controls Contractor. All future patches to the software shall be made available to the Departmental Representative.
- .4 Repairs required by a total system failure, or the malfunction of any priority portion of the system shall be considered an emergency repair, and shall be performed within eight (8) hours of the report of the failure.
- .5 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Provide written assurance that a local service centre will be maintained with a complete stock of replacement parts, and capable of servicing any and all troubles in the system.

- .7 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .8 Take note of and provide any extended warranties specified.

Part 2 Materials

2.1 ELECTRICAL COMPONENTS, WIRING AND CONDUIT

- .1 By Control Contractor (Division 23):
 - .1 All control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings and the electrical specification, which describes the limits of the extent to the work in Division 26 serving mechanical systems. Materials, equipment, connections and power not provided by Division 26 but required for the Control System shall be provided under this section.
 - .2 All control circuit transformers (120/1/60 or 24/1/60 as required by device).
 - .3 All control wiring and metallic conduit for mechanical system controls.
 - .4 Supply, installation and connection of all electric control items including: damper motors, relays, outside sensors, sub-master control circuits, safety devices, electric thermostats, aquastats, flow switches, wiring to terminal strips, proportional controllers, controllers, etc.
 - .5 All wiring and conduit from power distribution system to any control devices needing power (including B.M.S components)
 - .6 Be responsible for coordinating with Division 26.
 - .7 Electrical work installed under Division 23 shall be to the standards specified under Division 26.
- .2 By Division 26:
 - .1 All power wiring and conduit from power distribution system up to and including connection to all motors and starters.
 - .2 All disconnect switches required (unless specified in schedules as being integral with equipment).
 - .3 All motor protection switches, stop-start switches, magnetic starters, contactors, and hand-off-automatic selector switches except those supplied as part of packaged equipment.

- .4 Terminal strips within the motor control centres (MCC) for control connections.
- .5 Fire alarm signals.
- .3 Note:
 - .1 All magnetic starters for equipment shall have the following features supplied under Division 26:
 - .1 Hand-off-automatic selector or on-off selector, or start-stop buttons in cover with hand-automatic bridge if applicable.
 - .2 Pilot light.
 - .3 120 volt coils.
 - .4 120 volt control transformer.
 - .5 Four auxiliary dry contacts for interlocks; two normally open and two normally closed.
 - .2 The Controls Contractor is responsible for reading Division 26 plans and specifications to determine scope of responsibility and standards.
- .4 Wiring:
 - .1 Wire:
 - .1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.
 - .2 Line voltage control wiring - #14-gauge copper wire, length not to exceed 50 meters; #12-gauge copper wire, lengths exceeding 50 meters.
 - .3 Low voltage - minimum #22-gauge wire as directed by applicable electrical codes and requirements. 24-gauge wire for thermostat cables
 - .2 Cable:
 - .1 Data transmission cable shall be minimum #18 gauge twisted pairs (shielding as per manufacturers recommendations).
 - .3 Note:
 - .1 Run carrier system parallel to building lines.
 - .2 Support conduit carrier system every one meter independent of piping, ductwork and equipment.
 - .3 All wiring shall be concealed in finished spaces.

- .4 Seal all penetrations through fire separations or walls as per code requirements.
- .5 Identify all junction box covers with control company label.
- .6 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5m intervals along the length. Identification bands to be sprayed on and not less than 100mm wide. Bands to be pink in colour unless in conflict with Division 26 colours.
- .7 Use colour coded conductors.
- .8 Adhere to all applicable electrical codes and regulations.
- .9 Obtain electrical permit.
- .10 For non-CSA equipment where required by electrical code, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.

2.2 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

- .1 The following equipment shall be supplied under this section but installed under the appropriate trade sections of Division 23:
 - .1 Automatic control dampers.
 - .2 Pressure tappings.
 - .3 Static pressure sensors.
- .2 The Controls Subcontractor shall be responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and readily accessible location.

Part 3 Execution

3.1 ALARMS - GENERAL

- .1 No alarm shall be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this effect.
- .2 Generate an alarm on the B.M.S. if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range.

3.2 IDENTIFICATION

- .1 Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metalphoto or lamicoid labels and secure them to, or adjacent to, the control devices with key chains or cable ties.
- .2 All manual switches supplied by this trade, unless they come with standard nameplates, shall be labelled with engraved lamicoid plastic nameplates

to clearly indicate the service. Wording on nameplates shall be subject to approval by the Departmental Representative.

- .3 Where "day" and "night" thermostats are adjacent to one another they shall be labelled with engraved lamicaid plastic nameplates.
- .4 Mount an input/output layout sheet within each main DDC panel. This sheet shall include the name of the points connected to each controller channel.
- .5 Identify all DDC panels and associated devices with symbols relating directly to the control diagram. Provide durable wire labels for each input and output point with the following information:
 - .1 Point descriptor.
 - .2 Point type and channel number.
 - .3 Corresponding DDC panel number.

3.3 SYSTEM COMMISSIONING AND CALIBRATION

- .1 Program each standalone DDC panel immediately following installation.
- .2 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during the Departmental Representative's Demonstration and Instruction period.
- .3 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.
- .4 Perform all modifications and alterations as required to correct any deficiencies noted during these tests.
- .5 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season.
- .6 Following each visit submit printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each DDC panel.

3.4 VERIFICATION OF SYSTEM COMMISSIONING

- .1 Preliminary Tests
 - .1 After installation of each part of the system and completion of mechanical and electrical hook-up, perform tests to confirm correct installation and functioning of equipment.
 - .2 Notify the Departmental Representative in writing at least seven days before testing is to take place stating the following:
 - .1 Location and part of system to be tested.
 - .2 Describe testing procedure and anticipated results.

- .3 Provide all necessary testing equipment and personnel.
 - .4 Perform tests in presence of the Departmental Representative.
 - .5 Demonstrate the proper operation of each component.
 - .6 Correct any deficiencies and re-test in the presence of the Departmental Representative, until designated part of the system performs satisfactorily.
- .2 Final Operational Acceptance Test
- .1 A final operational test of not less than thirty (30) consecutive days, twenty-four (24) hours per day, shall be conducted on the complete and total installed and operational Control System to demonstrate that it is functioning properly in accordance with all requirements of this specification. The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control algorithms, diagnostics, and all other software. If the equipment operates at an average effectiveness level (AEL) of at least 95% during the performance test period of thirty (30) consecutive calendar days, it will be deemed to have met the Acceptable Standard of Performance, and final acceptance of the system shall be made, provided the contractor has satisfied all other requirements of this specification. In the event the required AEL is not reached during the initial thirty (30) consecutive calendar day period, the final operational acceptance test period shall be extended on a day-to-day basis until the required AEL is reached for thirty (30) consecutive calendar days. The average effectiveness level (AEL) is defined as the ratio between the total thirty-day test period less any system downtime accumulated within that period, and the thirty-day test period. Downtime shall result whenever the control system is unable to fulfill all required functions detailed within this specification due to any malfunction of either BMS hardware or software. Any defect of hardware or software shall be corrected when it occurs before the test may be resumed. Downtime created by non-BMS equipment or activities will not be considered as downtime for the AEL calculation.

3.5 MAINTENANCE SERVICE DURING THE WARRANTY PERIOD

- .1 The Contractor shall provide all services, materials and equipment necessary for the maintenance of the entire Control System, for a period concurrent with the warranty period. Any necessary material required for the maintenance work shall be provided by the Contractor.
- .2 The Controls Contractor shall provide one minor inspection per quarter or as required by the manufacturer and two major inspections per year, and all service for the required maintenance.

- .3 Major Inspections: these inspections shall include but not be limited to the following:
 - .1 Work as detailed hereinafter for minor inspections.
 - .2 Clean all peripheral equipment, CPU, interface panels, multiplexing panels and microprocessor interior and exterior surfaces.
 - .3 Provide signal, voltage and system isolation checks of all CPU, interface panels, multiplexing panels and peripherals.
 - .4 Provide mechanical adjustments, new ribbons and necessary maintenance on printers.
 - .5 Check and/or calibrate each field input/output device.
 - .6 Run system software diagnostics as required.
- .4 Minor Inspections: These inspections shall include but not be limited to the following:
 - .1 Provide visual and operational checks to all CPU, peripheral equipment, interface panels, multiplexing panels, and field devices.
 - .2 Change filter and check fan for all CPU's peripheral equipment as required.
 - .3 Provide complete back up of BMS system.
 - .4 Regular service calls: these calls shall be performed during regular working hours, 8:00 a.m. to 4:30 p.m. Monday through Friday excluding legal holidays.
- .5 Emergency Service: the Departmental Representative will initiate service calls when there is indication that the control system is not functioning properly. The Contractor shall have qualified control personnel available during the warranty period to provide service to the "critical" control system components whenever required at no additional cost to the Departmental Representative. The Contractor shall furnish the Departmental Representative with a telephone number where the service mechanic can be reached at all times. The service mechanic shall be on the job ready to service the control system within the next eight (8) hours, after receiving a request for service and the work shall be performed continuously until the control system is back in reliable operating condition. Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Records and Logs: records and logs shall be kept of each maintenance task.

- .7 System Modifications: recommendations for system modification shall be provided in writing to the Departmental Representative. No system modification, including operating parameters and control settings, shall be made without prior approval.
- .8 Software: provide implementation of all software maintenance updates. These shall be accomplished as required and full coordination with control system supervisory personnel shall be maintained.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Provide all remote sensing points and instrumentation as required for the complete operational capability of the Control System. All sensors shall have the accuracies as stated hereinafter. Hysteresis, relaxation time, span, maximum / minimum limits, etc. shall also be accounted for in all application of sensors and controls.
- .2 All instruments of a particular category shall be of the same type and manufacture.
- .3 All external trim material shall be completely corrosion resistant with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.
- .4 Use standard conduit box termination with screwdriver connector block unless otherwise specifically stated.
- .5 Operating conditions 0°C to 60°C with 10-90% RH (non-condensing) unless otherwise specifically stated.

1.2 RELATED SECTIONS

- .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 Section 23 09 01 Controls General
 - .2 Section 23 09 93 Control Sequences of Operation
 - .3 Section 23 09 94 Controls Points List for HVAC

Part 2 Products

2.1 CONTROL DAMPER ACTUATORS

- .1 General:
 - .1 Valve operators shall allow smooth operation of the valve throughout its entire range and assure tight shut-off against system pressure.
 - .2 Valve actuator shall be easily removed from the valve body for replacement.
- .2 Proportional Control Valve Actuators (VME):
 - .1 The valve actuator shall modulate the control valve between the fully open and closed position based upon a 0-10 VDC or 4-20 mA control signal. The actuator shall remain in its position until the applied signal changes. In the event of a control signal loss, the actuator shall move to the zero voltage input position.
 - .2 The valve shall maintain its shutoff force even if power is lost.

2.2 DAMPER ACTUATORS

- .1 General:
 - .1 Provide 120 or 24 volt electric or piston type pneumatic damper actuators where indicated or required.
 - .2 Damper actuators for all fan devices, all control dampers and all smoke/fire dampers shall be supplied by this trade. Refer to the drawings for control and smoke/fire dampers.
 - .3 Damper actuators shall meet the requirements of the unit manufacturer in all cases.
 - .4 Spring return for "fail-safe" in Normally Open or Normally Closed position where required.
 - .5 Size actuators to control dampers against maximum pressure or dynamic closing pressure whichever is greater.
 - .6 Size damper actuators so that they will provide smooth and full travel of the dampers while stroking in both directions.
 - .7 Where individual dampers are installed, install a separate damper actuator for each damper.
 - .8 Where multi-section dampers are installed, install a separate damper actuator for each section.
 - .9 Locate damper actuator so that they are easily accessible for testing and servicing.
- .2 Electronic Damper Actuators (DME & DTE):
 - .1 Actuators shall be direct coupled enabling it to be mounted directly to the damper shaft without the need for connecting linkage.
 - .2 The actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 - .3 Proportional actuators shall accept a 2 to 10 VAC or 4 to 20 mA signal.

2.3 CONTROL VALVES

- .1 All characteristics of control valves shall be suited to the required application. Three-way valves shall be linear for each port giving constant flow, and two-way valves shall have modified linear flow characteristics.
- .2 All valves shall be plug type with stainless steel stems and EPT ring pads or teflon packing.

- .3 Valve pressure / temperature rating - minimum ANSI Class 125.
- .4 Plugs shall be brass with molded composition discs.
- .5 Discs (renewable) shall be bronze for media 110°C or less and stainless steel for media above 110°C operating temperature.
- .6 Valve bodies for NPS ½ shall be screwed cast brass with integral seat.
- .7 Valves NPS ¾ to NPS 2 shall have screened cast brass body and cast brass cage with integral seat.
- .8 Valve bodies for NPS 2½ and up shall be cast iron flanged.
- .9 All control valves supplied with positive positioning relay shall have a minimum of 27-76 kPa spring range.
- .10 Note:
 - .1 Size control valves according to capacities and pressure drops as indicated in the schedules.
 - .2 Clearly identify the control valve coefficient (Cv) rating on valve bodies.
 - .3 Heating 3-way valve shall fail open to the heating coil.
 - .4 Control valves to be supplied by this trade for installation by others.

2.4 CONTROL VALVE ACTUATORS

- .1 General:
 - .1 Valve operators shall allow smooth operation of the valve throughout its entire range and assure tight shut-off against system pressure.
 - .2 Valve actuator shall be easily removed from the valve body for replacement.
- .2 Proportional Control Valve Actuators (VME):
 - .1 The valve actuator shall modulate the control valve between the fully open and closed position based upon a 0-10 VDC or 4-20 mA control signal. The actuator shall remain in its position until the applied signal changes. In the event of a control signal loss, the actuator shall move to the zero voltage input position.
 - .2 The valve shall maintain its shutoff force even if power is lost.

2.5 CONTROL PANELS

- .1 General:
 - .1 Fabricate from prime and enamel coated steel suitable for flush mounting complete with mounting legs.

- .2 Panel doors shall be hinged and complete with locks.
- .3 Construct so that instruments and gauges are flush mounted.
- .4 Provide sub-panel, inside control panel, for mounting control components.
- .5 Adhere lamicoid nameplates on the control panels to clearly identify the service of each device.
- .6 Submit shop drawings of control panel for review.
- .2 Panel mounted devices:
 - .1 Temperature gauges and manual reset (where applicable) for:
 - .1 Outdoor air.
 - .2 Return air.
 - .3 Mixed air.
 - .4 Discharge air (each zone).
 - .5 Hot water supply.
 - .6 Hot water return (each coil).

2.6 DIFFERENTIAL PRESSURE TRANSMITTERS (DPT)

- .1 Provide differential pressure transmitters having the following minimum specifications:
 - .1 Internal materials to be suitable for continuous contact with the process material measured including compressed air, water, glycol or steam as applicable.
 - .2 Output signal of 4 - 20 mA into a maximum of 500 ohm load.
 - .3 Output variations of less than 0.2% full scale for supply voltage variations of +/- 10%.
 - .4 Combined non-linearity, repeatability and hysteresis effects not to exceed +/- 1% of full scale output over entire range.
 - .5 Integral zero and span adjustment.
 - .6 Temperature effect of +/- 1.5% full scale/50°C or less.
 - .7 Output short circuit and open circuit protection.
 - .8 Over-pressure input protection to a minimum of twice rated input.

2.7 ELECTRIC RELAYS (ER)

- .1 Provide DPDT relays for control and status indication of alarms and/or electrical starters and equipment.

- .2 Relay coils shall be rated for 120V or 24V. Where other voltages occur provide transformer.
- .3 Contacts rated at 5 amps at 120V AC.
- .4 Relays to be plug in type with termination base.

2.8 FLOW SWITCHES (FSW)

- .1 Minimum Requirements:
 - .1 Single pole double throw action.
 - .2 Adjustable sensitivity.
 - .3 Extended trimmable paddles.
 - .4 Selected for minimum flow condition.
- .2 Notes:
 - .1 Install in upright position in horizontal run of pipe.
 - .2 Install a minimum of 5 pipe diameters downstream of any valves, elbows, orifices or any other obstructions.
 - .3 Adhere to manufacturer's installation recommendations.

2.9 FREEZE PROTECTION

- .1 Freeze protection thermostats shall be manual reset type with 6 m averaging element. Provide multiple thermostats for large duct cross sectional areas.
- .2 For liquids, elements shall be rigid bulb type mounted in separable wells.
- .3 Freeze protection elements shall be hard wired to the fan starter and also wired to the B.M.S. or alarm system.

2.10 ROOM THERMOSTATS

- .1 Minimum Requirements
 - .1 Adjustable sensitivity and set point.
 - .2 Electric.
 - .1 Low or line voltage as specified.
 - .3 Standard metal or Lexan covers.
 - .1 Visible thermometer (thermostats only) graduated in deg.C.
 - .2 Concealed set-point adjustment (or removable key adjustment).
 - .3 Lock key covers.
 - .4 Room thermostats sensors shall be tamper resistant. Suitable for CSC operations.

.2 Note:

- .1 Provide a key for each instrument requiring a removable key. Obtain signed receipt from the Departmental Representative certifying that the keys have been received.

2.11 TEMPERATURE SENSORS

- .1 General: Temperature sensors shall be thermistor, resistance or thermocouple type, however, thermocouples shall be restricted to temperature range +200°C and above.
- .2 The following shall apply to thermistor, resistance or thermocouple temperature sensors as applicable.
 - .1 RTDs shall be 100 ohm or 1,000 ohm at 0°C (+/- .2 ohm) nickel or platinum element with strain minimizing construction and 3 integral anchored leadwires coefficient of resistivity of 0.000385 ohms/ohm/deg.C. Thermistors shall be 3,000 or 10,000 ohms.
 - .2 Sensing element to be hermetically sealed.
 - .3 Stem and tip construction to be copper or 304 stainless steel as noted.
 - .4 Sensors to have a time constant response of less than 3 seconds to a temperature change of 10°C.
 - .5 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.
 - .1 -50°C to +50°C, plus or minus 0.5°C.
 - .2 0°C to +50°C, plus or minus 0.25°C.
 - .3 0°C to 25°C, plus or minus 0.1°C.
 - .4 0°C to 100°C, plus or minus 1°C.
 - .6 Immersion wells shall be of stainless steel materials for steam and domestic hot water and brass for other applications. Heat transfer compound to be compatible with sensor.
- .3 Temperature sensors shall be of the following types:
 - .1 Room type (RTS) - suitable for wall mounting, with protective guard. Element length of 10-50 mm with ceramic tube or equivalent mode of mechanical protection.
 - .2 General purpose duct type (DTS) - suitable for insertion into air ducts at any angle, insertion length shall be suitable for application. Copper sheathed construction.
 - .3 Spring-loaded thermowell type (ITS) - spring loaded construction with compression fitting for 20 mm NPT well mounting. Lengths shall be suitable for application. Stainless steel sheathed construction.

- .4 Averaging duct type (ATS) - continuous filament with immersion length of 6000 mm minimum. Probe to be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance. Copper sheathed construction. Or multiple sensors mounted on a cable connected to provide an average temperature reading
- .5 Outside air type (OTS) - complete with non-corroding shield designed to minimize solar and wind effects, threaded fitting for mating to 12 mm conduit, probe length of 100 - 150 mm.

2.12 VARIABLE SPEED DRIVE CONTROLLER

- .1 Minimum Requirements:
 - .1 Unit to operate with an input, line side power factor of 0.94 or better at all speeds and loads.
 - .2 All units supplied to the project must be of the same manufacturer and model type.
 - .3 Factory C.S.A. certified.
 - .4 Unit to operate in ambient temperatures ranging from 0° C to +40° C.
 - .5 Unit to operate at full load with a variation of -15% and +10% of rated building voltage.
 - .6 Unit to operate at full load with a variation of +5% of rated frequency.
 - .7 Printed circuit board design using the latest "state of the art" components including microprocessor control of protective circuits.
 - .8 Suitable for use with the standard or high efficiency EEMAC Design B motors used on this project.
 - .9 VSD module and all additional peripheral components as specified herein, to be integrated and mounted in one common EEMAC 1 (use EEMAC 3R for outdoor units) wall or floor mounted enclosure.
 - .10 Transformers shall not be used on either the input or output of unit.
 - .11 The VSD shall have an adjustable PWM carrier/switching frequency from nominal 1 through 12 kHz. Units unable to adjust to a minimum upper level of 12 kHz are not acceptable. Maximum switching frequency of 16 kHz.
 - .12 The VSD shall include reactors or LRC filters as necessary to protect the motor from PWM - IGBT voltage spikes and limit the voltage rise times and maximum peak voltages throughout the specified building voltage range and for all operating conditions at the related motor connections as follows:

- .1 Maximum peak voltage 1000 volts.
- .2 Maximum voltage rate of rise: 500 volts/microsecond.
- .13 Unit shall be provided with protection against:
 - .1 Stalls caused by overcurrent.
 - .2 Stalls caused by regenerative overvoltage.
 - .3 Overcurrent protection.,
 - .4 Regenerative overvoltage protection.
 - .5 Overload protection (thermal type).
 - .6 Ground fault protection.
 - .7 Instantaneous power failure protection.
 - .8 Alarm against overload.
 - .9 Overtemperature of heat sink.
 - .10 Input power under voltage, over voltage and phase loss.
 - .11 DC bus over voltage.
- .14 The unit shall have the following features:
 - .1 Adjustable acceleration and deceleration. Across the line starting shall not be possible. A ramp up time from 0 RPM to 1800 RPM of 30 seconds shall be the minimum possible ramp up time.
 - .2 Dynamic breaking for acceleration and stopping.
 - .3 Critical speed avoidance will allow for the selection of two skip speeds and a rejection band of 0 – 10Hz around each speed.
 - .4 Voltage/frequency ratio and adjustment.
 - .5 Power failure restart to be selectable and programmable for number of attempt's & time interval between attempt's. Unit also to have circuits to permit a start into a rotating motor, in either direction without trip or failure.
 - .6 Frequency range (output) 2 - 60 Hz minimum.
 - .7 Frequency resolution of 0.5 Hz or better.
 - .8 Frequency accuracy of +/-0.5% at 25°C.
 - .9 Able to accept a 4-20 milliamp, 0 to 5 vdc or 0 to 10 vdc external control signal for speed control.
 - .10 Able to accept a remote start / stop control.

- .11 Minimum of 3 programmable preset speeds to facilitate operation of the unit from interlocks, at fixed speeds.
- .15 Provide EMI filters to reduce EMI to FCC acceptance levels.
- .16 The units shall have the following components:
 - .1 Run and Stop pushbuttons or switch.
 - .2 Hand-Off-Auto selector switch.
 - .3 Manual speed adjusting potentiometer.
 - .4 Fused disconnect switch rated for the full connected load and complete with lockable, through door operator, defeatable with screwdriver. Fuses to be suitable semiconductor rated.
 - .5 Trip relay with light.
 - .6 Run relay with light.
 - .7 Analogue speed indicator, 0 - 110%, 50mm bezel minimum.
 - .8 110 volt control transformer, fused in the primary and secondary.
 - .9 Auto reset thermal overload - relay interlocked in run circuit.
 - .10 Terminal strip to accept N.C. safety contacts such as freeze stats and smoke alarms to safety shut down VSD when in Hand or Auto position.
 - .11 N2 Interface card for interface with BMS to provide full control, status and alarm interface.
 - .12 Form C contacts to indicate run mode.
 - .13 Form C contacts to indicate fault or alarm mode.
 - .14 0 to 10 vdc output signal directly proportional to controller's speed.
 - .15 Provide integral factory wired and mounted bypass provisions, where scheduled, such that the controlled motors can be manually put into operation bypassing the VSD. Bypass to consist of a motor contactor and overload relay rated for the connected load. The bypass must have its own isolating device to allow corrective work on the VSD whilst operating in the bypass mode. Bypass contactor and VSD must be fully interlocked to prevent both outputs being enabled simultaneously. Control of the bypass will be by means of an enclosure door mounted VSD Bypass selector and Start Stop pushbuttons. Two door mounted lamps shall be provided to indicate operating mode (VSD or Bypass).

- .17 Units shall be equipped with a 5% line reactor and a harmonic filter on the power input side to prevent the backfeeding of harmonics into the power system. Filters should control the THD within the values specified by IEEE 519.
- .18 Refer to Schedule - VARIABLE SPEED DRIVES.
- .19 VSD's shall be installed by the Controls Contractor. All power wiring connections shall be by Division 16 and all control wiring by the Controls Contractor.
- .20 The manufacturer's representative shall be present at start-up and shall supervise the start-up and test the voltage at the motor connection with the Commissioning Agency present with a digital oscilloscope with storage capacity and with a sufficiently fast sample time to accurately measure voltage rate of rise to confirm that the voltage spikes and rate of rise are within the specified level. Submit the results to the Departmental Representative including the input voltage on all three phases to the VSD at the time of measurement.
- .21 The manufacturer's representative shall be present for a minimum of 1/2 day to instruct the building maintenance personnel in the correct use and operation of the VSD units following the commissioning of the systems.
- .22 Provide a parts and labour warranty for three years subsequent to Substantial Completion for the Variable Speed Drives.
- .23 Provide a three year parts and labour warranty against VSD related failure for each motor connected to a VSD power output.
- .24 Shop drawings shall include:
 - .1 Dimensional drawings.
 - .2 All connection points.
 - .3 Power circuit diagrams.
 - .4 Installation and maintenance manuals.
 - .5 Warranty description.
 - .6 Certification of agency approvals.
 - .7 Conformance to each specified requirement.
 - .8 Placement of input and output reactors / filters, EMI filters, semi-conductor rated fuses (where required).
 - .9 Harmonic analysis indicating the level of harmonic distortion that the drives will cause.

- .25 Variable speed drives shall be configured with hand-off-auto override capability. For applicable fans, the hand position shall override the normal EMCS control output but not the FFPC control output or the freeze protection interlock. When the VSD is bypassed for maintenance or due to failure the controlled motor shall operate as if in hand position such that the FFPC control output and the freeze protection interlock (if applicable) are not overridden.

2.13 VARIABLE SPEED DRIVE CONTROLLER (PACKAGED)

- .1 Variable speed motor drive controllers have been specified to be provided as part of air handling units packages, to be supplied by the mechanical contractor, wired and connected by Division 26 (Power Wiring) and control wiring by the controls subtrade (under this contract). Refer to individual building contract document for specified product information, etc.

Part 3 Execution

3.1 GENERAL

- .1 All equipment shall be installed according to manufacturers' published instructions.
- .2 Temperature, Humidity Sensors, Thermostats and Humidistats:
- .1 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.
 - .2 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.
 - .3 Install corridor instruments at a height of 2.1 m above the finished floor.
 - .4 Locate instruments in the same vertical centreline as light switches.
 - .5 Where instruments are indicated on an outside wall install on a stand-off wall bracket which provides an air space between the instrument and the wall; or on an insulating base (e.g. a cork pad).
 - .6 Install protective metal guards on instruments in areas where they may be subject to damage (loading areas, gymnasiums, workshops, public corridors and storage areas). Bolt guards, independent of instruments to separate baseplates. Provide backing in wall for securing mounting bases.

- .7 Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only, and shall not be located in dead air spaces. The location shall be within the vibration and velocity limits of the sensor. Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct to measure the best average temperatures. Elements shall be thermally isolated from brackets and supports to respond to air temperature only. Sensor element to be supported separately and not connected to coils or filter racks.
- .8 Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to effect proper flow across the entire area of the well. Well shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area.
- .3 Temperature Transmitters, Humidity Transmitters, Solenoid Air Valves, Controllers and relays to be installed in NEMA I enclosures.
 - .1 Panels to be either free standing or wall mounted ANSI 61 polyester powder coated steel cabinets with hinged and key locked front door. Arrange for conduit and tubing entry from top, bottom or either side.
 - .2 Panels shall be modular multiple panels being used if required for capacity in any particular location.
 - .3 All panels shall be lockable with same key.
 - .4 All wiring and tubing within panels to be located in trays or individually clipped to back of panel, and clearly identified.
- .4 All field devices to be properly identified.
- .5 Mount electrical instruments on standard electrical rough-in boxes fastened to structure.
- .6 Testing:
 - .1 All field devices shall be properly calibrated and tested for performance and accuracy. A report detailing test performed and results to be submitted to the departmental representative for approval. The departmental representative will verify results at random. Provide all testing equipment necessary. Provide manpower necessary to assist with the verification.

END OF SECTION

1 GENERAL

1.1 Related Sections:

- .1 Section 23 09 01 – Controls General Requirements.
- .2 Section 23 09 13 – Control Devices and Instrumentation.
- .3 Section 23 09 94 – Controls Points List for HVAC.

2 PRODUCTS

- .1 In accordance with Section 23 09 13 Controls Devices and Instrumentation.

3 EXECUTION

3.1 HVAC Control Objectives:

- .1 Program the system to meet the following objectives:
 - .1 Temperature:
 - .1 Control the temperature in each occupied space.
 - .2 Ventilation:
 - .1 Control the system's minimum outdoor air intake and supply to each zone to meet either minimum outside air flow rate as specified herein.
 - .3 Energy:
 - .1 Provide no more heating and cooling than is essential during Normal Operation.
 - .4 Operation:
 - .1 Systems shall remain under BMS control during all operating conditions (unoccupied mode, occupied mode)
 - .2 Modify setpoints and provide alarms

3.2 Monitoring:

- .1 The BMS monitors the following conditions and parameters as a minimum:
 - .1 HVAC equipment, fans, and pumps operation and status
 - .2 VSD / VFD operation and status
 - .3 Control valve and damper positions
 - .4 Supply, return, and mixed air temperature
 - .5 Outdoor air temperature and enthalpy
 - .6 Zone air temperature and enthalpy
 - .7 Differential pressure drop across the air filter sections

.8 Alarms and setpoints

3.3 Alarms and Safeties:

.1 The existing duct mounted smoke detector shall be reused. See electrical drawings and specifications.

4 EQUIPMENT AND SUBSYSTEMS CONTROL SEQUENCES:

4.1 Fan System (F-9)

.1 Components:

.1 Fan (F-9)

.2 Normal Operation: Fan shall run continuously during scheduled operation.

.1 DDC shall enable and disable fan operation.

**4.2 Fan System (F-15), Heating Coil (HC-2), Circulation Pump (P-4),
Components:**

.1 Fans (F-x) and dampers

.2 Heating Coils (HC-x) and valves (CV-x)

.3 Pumps (P-x)

.2 Normal Operation: Fan shall run continuously during the scheduled operation.

.1 System Stopped:

.1 Supply fan stopped.

.2 O/A damper closed.

.2 System Start/Operation:

.1 Supply fan shall operate continuously. Damper shall open and fan enabled.

.2 Heating Mode shall be enabled upon a call for heating from the room temperature sensor. Heating coil control valve shall modulate open. Circulation pump shall be enabled.

.3 Heating mode shall be disabled when room temperature sensor setpoint has been satisfied. Circulation pump shall be disabled. Heating coil control valve shall modulate closed.

.4 Freeze protection: When entering outdoor air temperature drops below freezing, control valve shall open, and circulation pump shall be enabled.

- 4.3 Fan System (F-16), Heating Coil (HC-1), Circulation Pump (P-3),
Fan Systems (F-17), Heating Coil (HC-4), Circulation Pump (P-7)**
- .1 Components:
 - .1 Fans (F-x) and dampers
 - .2 Heating Coils (HC-x) and valves (CV-x)
 - .3 Pumps (P-x)
 - .2 Normal Operation: Fan shall run continuously during the scheduled operation.
 - .1 System Stopped:
 - .1 Supply fan stopped.
 - .2 O/A damper closed.
 - .3 R/A damper closed.
 - .2 System Start/Operation:
 - .1 Supply fan shall operate continuously. Dampers shall open and fan enabled. O/A damper shall be set to 75% open. R/A damper shall be set to 25% open.
 - .2 Heating Mode shall be enabled upon a call for heating from the room temperature sensor. Heating coil control valve shall modulate open. Circulation pump shall be enabled.
 - .3 Heating mode shall be disabled when room temperature sensor setpoint has been satisfied. Circulation pump shall be disabled. Heating coil control valve shall module closed.
 - .4 Freeze protection: When entering outdoor air temperature drops below freezing, control valve shall open, and circulation pump shall be enabled.
 - .5 Free cooling: O/A damper shall open to 100% when O/A conditions allow for free cooling. R/A damper shall close.

END OF SECTION

1 GENERAL

1.1 Related Sections

- .1 Section 23 09 01 – Controls General Requirements
- .2 Section 23 09 93 – Controls Sequences of Operations

1.2 General

- .1 The following points list indicates the input and output points that shall be connected to the Building Automation System (BAS). Any additional points that are noted in Section 23 09 93 to be under DDC control shall also be included as if they were on the points list. All points associated with one mechanical system shall be connected to the same Stand Alone Panel (SAP).
- .2 Program alarms as specified in the points list and sequences with user adjustable alarm thresholds. Provide descriptors for all programmed alarms which can be accessed via the graphics at the Operator Work Station (OWS).

1.3 Device Legend

- .1 Refer to Section 23 09 01 for specification of devices.
- .2 RTS = Room Temperature Sensor
- .3 DTS = Duct Temperature Sensor
- .4 ITS = Immersion temperature Sensor
- .5 ATS = Averaging Duct Temperature Sensor
- .6 OTS = Outdoor Temperature Sensor
- .7 HS = Humidity Sensor
- .8 DPT = Differential Pressure Transmitters
- .9 SPT = Static Pressure Transmitter
- .10 VPT = Velocity Pressure Transmitter
- .11 PSW = Pressure Switch
- .12 TSW = Temperature Switch
- .13 IPT = Current / Pneumatic Transducer
- .14 CR = Current Relay
- .15 ER = Electric Relay
- .16 PR = Pneumatic Relay
- .17 FSW = Flow Switch
- .18 ESW = End Switch

- .19 DME = Damper Actuator Modulating Electronic
- .20 DTE = Damper Actuator Two Position Electronic
- .21 DMI = Damper Actuator Modulating Incremental Control
- .22 VME = Valve Actuator Modulating Electronic
- .23 VTE = Valve Actuator Two Position Electronic
- .24 VMI = Valve Actuator Modulating Incremental Control
- .25 MFT = VAV Box Flow Transmitter
- .26 FMS = Electronic Flow Measuring Station
- .27 VSD / VFD = Variable Speed Drive / Variable Frequency Drive
- .28 BAC = BACnet packaged controller

1.4 **Table Legend**

- .1 **DI** = DIGITAL INPUT; **DO** = DIGITAL OUTPUT; **AI** = ANALOG INPUT; **AO** = ANALOG OUTPUT; **X** = TUC POINT; **H** = HIGH ALARM; **L** = LOW ALARM; **S** = STATUS ALARM

1.5 **Input / Output Points List**

- .1 Provide full integration into the existing controls and connect to all new points.
- .2 Show all points on graphics (typical)
- .3 Show VFD power input on graphics (typical)

1.6 System: Fan F-9

.1 Provide full integration of the Fan components to the existing BAS.

Unit No.	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
F-9	E/A fan enable / disable			X			FAIL	

1.7 System: Fan F-15, Heating Coil HC-2 and Circulation Pump P-4

.1 Provide full integration of the HVAC components to the existing BAS.

Unit No.	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	F-15 S/A fan motor enabled				X			
	F-15 S/A fan status, VFD Speed		X				FAIL	
	F-15 O/A damper status/posn		X		X		FAIL	DME
	F-15 O/A temperature		X				LO	DTS
	F-15 S/A temperature		X				HI	DTS
	F-15 Air Filter differential press.		X				HI	DPT
	HC-2 HWS temperature		X				HI/LO	ITS
	HC-2 HWR temperature		X				HI/LO	ITS
CV-HC2	3-Way control valve position		X		X		FAIL	DME
P-4	Pump P-4 enable/disable				X		FAIL	
	Room temperature		X				HI/LO	RTS
	Room temperature set point		X		X			RTS

1.8 System: Fan F-16, Exist. Heating Coil HC-1 and Circulation Pump P-3

.1 Provide full integration of the HVAC components to the existing BAS.

Unit No.	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	F-16 S/A fan motor enabled				X			
	F-16 S/A fan status, VFD Speed		X				FAIL	
	F-16 O/A damper status/posn		X		X		FAIL	DME
	F-16 O/A temperature		X				LO	DTS
	F-16 S/A temperature		X				HI	DTS
	F-16 R/A damper status/posn		X		X		FAIL	DME
	F-16 Air Filter differential press.		X				HI	DPT
	Duct Freeze Stat				X		LO	ATS
	HC-1 HWS temperature		X				HI/LO	ITS
	HC-1 HWR temperature		X				HI/LO	ITS
CV-HC1	3-Way control valve position		X		X		FAIL	DME
P-3	Pump P-3 enable/disable				X		FAIL	
	Room temperature		X				HI/LO	RTS
	Room temperature set point		X		X			RTS

1.9 System: Fan F-17, Heating Coil HC-4 and Circulation Pump P-7

.1 Provide full integration of the HVAC components to the existing BAS.

Unit No.	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	F-17 S/A fan motor enabled				X			
	F-17 S/A fan status, VFD Speed		X				FAIL	
	F-17 O/A damper status/posn		X		X		FAIL	DME
	F-17 O/A temperature		X				LO	DTS
	F-17 S/A temperature		X				HI	DTS
	F-17 R/A damper status/posn		X		X		FAIL	DME
	F-17 Air Filter differential press.		X				HI	DPT
	Duct Freeze Stat				X		LO	ATS
	HC-4 HWS temperature		X				HI/LO	ITS
	HC-4 HWR temperature		X				HI/LO	ITS
CV-HC4	3-Way control valve position		X		X		FAIL	DME
P-7	Pump P-7 enable/disable				X		FAIL	
	Room temperature		X				HI/LO	RTS
	Room temperature set point		X		X			RTS

END OF SECTION

1 GENERAL

1.1 Related Work

- .1 Section 23 05 49 Seismic Restraints.
- .2 Section 23 09 01 Controls General.

1.2 Reference Standards

- .1 Do all piping system work in accordance with ASME/ANSI B31.9-17 code and CSA B51-19.

1.3 Regulatory Requirements

- .1 Installation of, and repair or alterations to, pressure piping systems shall be performed only by licensed Contractors and licensed Welders, certified for the work being done in accordance with the Regulations and Requirements of the Province of British Columbia "Power Engineers Boiler and Pressure Vessel Safety Act and Regulations".
- .2 All field welding to be in accordance with the procedures of CSA-W117.2-19 and the current edition of ASME/ANSI B31.1-18 or B31.9-17 Code.

1.4 System Pressure Ratings

- .1 Pipe Fittings:
 - .1 Piping systems 860 kPa or less operating pressure - 860 kPa rating.
- .2 Valves:
 - .1 Suitable for maximum system operating temperature and pressure.

2 PRODUCTS

2.1 General

- .1 All products shall be registered with the regulatory authority in accordance with CSA B51-19.
- .2 There shall be no press-fit or grooved mechanical couplings.

2.2 Pipe

- .1 Steel Pipe:
 - .1 to NPS 10, Schedule 40 to ASTM A53 Grade B or NPS 3/4 to NPS 2 to ASTM A795/A795M-13(2020), Schedule 5,
 - .2 to NPS 12 and over, 9.5 mm wall thickness to ASTM A53/A53M-18 Grade B.
 - .3 for the following systems:
 - .1 Hot water heating (glycol).

2.3 Pipe Joints - Steel Piping

- .1 NPS 2 and under: screwed fittings, except where otherwise noted, with

teflon tape and retroseal teflon paste or pipe dope.

- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W47.1-19.
- .3 Flanges: raised face, steel weld neck, lap or back-welded slip on type. Use flat face for attachment to cast iron valves.
- .4 Flange Bolts and Nuts, carbon steel: to ANSI B18.2.1-12 and ANSI B18.2.2-15.
- .5 Flange gaskets:
 - .1 Up to 860 kPa system pressure - non-asbestos gaskets for mating surfaces.
 - .2 Over 860 kPa system pressure - stainless steel spiral wound non-asbestos gaskets.

2.4 Pipe Fittings - Steel Pipe

- .1 Pipe fittings, screwed, flanged or welded:
 - .1 Cast iron pipe flanges: Class 125 to ANSI B16.1-15.
 - .2 Cast iron screwed fittings: Class 125 to ANSI B16.3-16.
 - .3 Steel pipe flanges and flanged fittings: to ANSI B16.5-17.
 - .4 Steel butt-welding fittings: to ANSI B16.9-2018.
 - .5 Unions, malleable iron ground joint type: Class 150 to ANSI B16.3-16.

2.5 Valves General

- .1 Wherever possible all valves shall be of one manufacturer.
- .2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body. All valves must be suitable in all respects for service used.
- .3 Include lock shield handles where shown or noted.

2.6 Gate Valves

- .1 NPS 2 and under, screwed:
 - .1 Bronze body, rising stem, solid wedge disc, union or screwed bonnet.

2.7 Globe Valves

- .1 NPS 2 and under, screwed:
 - .1 Bronze body, rising stem, renewable composition or bronze disc, union bonnet.

2.8 Ball Valves

- .1 NPS 2 and under, screwed:
 - .1 Forged brass body, threaded cap, chrome plated ball, PTFE seats,

blow out proof stem.

- .2 Ball valves for isolation service shall have a large/full port.
- .3 Ball valves for balancing service shall have a reduced port and valve handle shall have a memory stop.
- .4 Acceptable Products:
 - .1 Class 600 W.O.G. - Crane F9202, Grinnell 3700, Kitz 58, Nibco T-585-70, Red-White/Toyo 5044A, Victaulic 722, or approved equal.

2.9 Circuit Balancing Valves

- .1 NPS 2 and under: copper alloy body, screwed, 'Y' pattern globe.
- .2 NPS 2-1/2 and over: cast iron body, flanged, 'Y' pattern globe.
- .3 Maximum pressure 1715 kPa and maximum temperature 121°C.
- .4 Calibrated balancing valve with memory, positive shut-off, inlet and outlet pressure measuring connections with integral shut-offs and drains.
- .5 Calibration charts and adjustment tools to be included.
- .6 Provide one (1) differential pressure meter kit suitable for direct readout c/w connection hoses suitable for the system pressure.

2.10 Swing Check Valves

- .1 NPS 2 and under, screwed:
 - .1 Bronze body, bronze swing disc, screw in cap, regrindable seat.

2.11 Drain Valves

- .1 Globe type, bronze body with bronze trim and composition disc.

2.12 Control Valves

- .1 See Section 23 09 01 Controls General.

3 EXECUTION

3.1 Piping

- .1 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly. Remove welding slag or other foreign material from piping.
- .2 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.
- .3 Screw, or weld, fittings (unless otherwise specified) for all piping systems up to NPS 2.
- .4 Install piping to conserve headroom and space. Run exposed piping parallel to walls. Do not block equipment access panels.
- .5 Maintain a minimum of 25 mm space between adjacent flanges or pipe

insulation, whichever has the larger diameter.

- .6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .7 Saddle type branch fittings may be used on mains, if branch line is half size or smaller than main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .8 Use long radius elbows.
- .9 Remake leaking joints using new materials, do not caulk or cement leaking threaded joints.
- .10 Use eccentric reducers at pipe size changes, flush on top side, to permit positive venting and drainage.
- .11 Do not use thread protection couplings, close nipples, running nipples or street elbows.
- .12 Avoid locating water and drain piping over electrical equipment. Where this is unavoidable, provide galvanized drip pans under such pipe and weld piping and fittings. Provide drain and piping from drip pans to satisfactory floor drain. Drainage for glycol filled piping shall be collected separately. Do not create tripping hazards.
- .13 Bull head tees shall not be used for converging flows.

3.2 Pipe Grading

- .1 Grade all piping to provide positive drainage and venting. Slope as follows:
 - .1 Supply mains and branches - up in the direction of flow, minimum 1:480 [1" in 40 ft].
 - .2 Return mains and branches - down in the direction of flow, minimum 1:480 [1" in 40 ft].

3.3 Connections to Equipment and to Existing Piping

- .1 Install unions, or flanges at connections to all equipment and specialty components and at all connecting points to existing systems which, for reasons of separation for testing, will require to be blank flanged or capped.
- .2 Connect to equipment in accordance with manufacturer's instruction unless otherwise noted.
- .3 Arrange piping connections to allow ease of access and for removal of equipment.
- .4 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.
- .5 Do not reduce equipment connection sizes by bushing.

- .6 Branch connections to existing steel piping may be made using double strap service saddles.
- .7 Where shut down of a service is not possible, a hot-tap process shall be used for the tie-in connection of the services. The hot-tap welding in-place requires special equipment and the services of a highly skilled journeyman welder. Submit qualifications of journeyman welder prior to commencing work.
- .8 When connecting to an existing antifreeze (or glycol) system, the antifreeze solution shall be drained into temporary storage tanks. Do not drain into sanitary / storm system.

3.4 Drain Connections

- .1 Pipe the discharge from all liquid relief valves, liquid safety valves, high capacity air vents, steam drip pan elbows, equipment blowdowns, water columns, overflows and piping system drains to the nearest building drain. Install a brass, bronze or copper receiving funnel on the drain where shown.
- .2 Drains from drain pans shall be DWV copper ASTM B306 32 mm minimum size.
- .3 Drain and vent piping shall be of the same material as the piping system to which it is connected, except where otherwise specified.
- .4 Where item being drained is under pressure, provide a deep seal trap.

3.5 Expansion of Piping

- .1 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building. Pay particular attention to piping running horizontal across building expansion joints and provide adequate expansion and contraction for all such piping.
- .2 Only major expansion configuration and fittings have been shown on the drawings. Provide all required additional compensators, loops and swing connections.
- .3 Provide anchors, where shown. Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31-18.
- .4 Expansion loops shall be of all welded construction with long radius elbows.
- .5 Install expansion loops, cold sprung 50% of the calculated expansion.
- .6 Install at least three (3) elbows in all branch connections. Where space does not permit three (3) elbows, install braided flexible pipe connectors in accordance with manufacturer's recommendations. Three (3) elbow branch connections shall have sufficient developed length to ensure that excessive stresses are not generated in the piping and in no case less than

900 mm.

3.6 Valves

- .1 Install valves with stems upright or angled 45° above horizontal unless approved otherwise.
- .2 Install control valves with their stems upright unless approved otherwise and with adequate clearance for removal of actuators.
- .3 Use gate valves or (ball valves NPS 2 and under) to shut off branch takeoffs and to isolate equipment.
- .4 Install balance fittings or valves in the return piping connections to each terminal heating and cooling unit - eg. radiators, unit heaters, fan coil units, heating and cooling coils.
- .5 Install radiator valves in the supply connections to each convection heating element.
- .6 Provide valves upstream of all meters, gauges, automatic air vents, etc. for isolation purposes.

3.7 Piping Tests

- .1 Notify the Departmental Representative and the Inspection Authority having jurisdiction, 48 hours in advance of intended test dates.
- .2 Before testing piping, isolate all equipment, which cannot withstand the test pressure.
- .3 Do not insulate, backfill or conceal until tests have been completed and approved by the inspection authorities.
- .4 Examine all systems under test for leaks.
- .5 Joints shall remain dry during the test. A general sweating around a weld shall be reason for rejection.
- .6 Remake all leaking connections and joints.
- .7 Tests shall be limited to new piping only.
- .8 New connections to existing piping shall be warranted.
- .9 Initial Hydrostatic test:
 - .1 150% of working pressure, but not less than 860 kPa [125 psig] for 1 working day.
- .10 Final Hydrostatic test:
 - .1 150% of working pressure, after piping connections to all equipment are complete, maintain until all parts of piping systems have been inspected.

3.8 Flushing and Cleaning

- .1 After completion of all piping tests, clean and flush all piping systems to remove all internal dirt, millscale, rust, piping dope, pipe reamings and slag. On completion of flushing, remove, clean and reinstall all strainer baskets.
- .1 Clean in accordance with Section 01 74 11 Cleaning and Special Cleaning Procedures.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

3.9 Testing, Adjusting, and Balancing

- .1 Test, adjust and balance all piping systems in accordance with Section 23 05 93 Testing, Adjusting, and Balancing

END OF SECTION

Part 1

General

1.1 SECTION INCLUDES

- .1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B214-16, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1-2016, Motors and Generators.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submit the following shop drawings:
 - .1 Inline Pumps P-3, P-4 and P-7
- .4 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .5 Submit product data of pump curves for review showing point of operation.
- .6 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
- .7 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction / Demolition Waste Management and Disposal.

Part 2

Products

2.1

EQUIPMENT

- .1 Refer to equipment schedules for capacities and supplemental requirements.
- .2 Do component selection and sizing to: CAN/CSA-B214-16.

2.2

IN-LINE CIRCULATORS

- .1 Inline, ECM (Motor) circulator
- .2 Water-tight, long-life silicon carbide mechanical seal and be suitable for 860 kPa working pressure, 1206 kPa at 110 deg.C maximum.
- .3 Material: cast iron, lead-free bronze, NSF-372-16 compliant.
- .4 Maintenance free bearings (no lubrication), stainless steel shaft
- .5 Mechanical seal, stationary seal face sintered silicon carbide
- .6 Shaft: alloy steel with bronze sleeve bearing, integral thrust collar.
- .7 Accessories: Strainer, suction guide, combination check/balance valve where scheduled.
- .8 Capacities: Refer to equipment schedules and schematics.

Part 3

Execution

3.1

INSTALLATION

- .1 Do Work in accordance with CAN/CSA-B214-16.
- .2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.
- .8 Vibration isolation per 23 05 48 Vibration Controls for HVAC Piping and Equipment.

3.2

START-UP

- .1 General
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements; supplemented as specified herein.
 - .2 In accordance with manufacturer's recommendations.

- .2 Procedures:
 - .1 Before starting pump, check that over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust water flow rate through water-cooled bearings.
 - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .10 Adjust alignment of piping and conduit to ensure true flexibility at all times.
 - .11 Eliminate cavitation, flashing and air entrainment.
 - .12 Adjust pump shaft seals, stuffing boxes, glands.
 - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
 - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
 - .15 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION (PV)

- .1 General
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
 - .2 In accordance with manufacturer's recommendations.
- .2 Assumptions: these PV procedures assume that:
 - .1 Manufacturer's performance curves are accurate.
 - .2 Valves on pump suction and discharge provide tight shut-off.
- .3 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in the Standard.

- .3 Where procedures do not exist, discontinue PV, report to DCC Representative and await instructions.
- .4 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .5 Commissioning Reports: In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:
 - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
 - .3 Pump performance curves (family of curves).

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to Section 23 07 13 Thermal Insulation for Ducting
- .2 Refer to Section 23 31 14 Metal Ducts Low Pressure to 500Pa

1.2 SUBMITTALS

- .1 Submit a schedule indicating the ductwork standards to be used, including metal gauges, joints, and reinforcements before construction of any ductwork.

1.3 REFERENCE STANDARDS

- .1 The construction and installation of ductwork and plenums shall be in accordance with the latest edition of the following referenced SMACNA manuals and ASHRAE handbooks.
 - .1 SMACNA - H.V.A.C. Duct Construction Standards.
 - .2 SMACNA - H.V.A.C. Air Duct Leakage Test Manual.
 - .3 ASHRAE - Handbook - Equipment Volume.

1.4 GENERAL

- .1 Duct sizes on drawings indicate clear inside dimensions. For acoustically lined or internally insulated ducts, maintain inside duct dimensions.
- .2 Where duct sizes are shown in nominal metric sizes, round and oval duct sizes may be supplied in the nearest available sizes in equivalent imperial units.
- .3 Proper sized openings shall be arranged for in the correct locations through all slabs and walls. Openings shall be planned to include for the installation of fire dampers at all rated fire separations.
- .4 Where ducts penetrate roofs, provide roof curbs with flashing and counterflashing.
- .5 The project drawings are diagrammatic and although efforts have been made to provide information regarding the number of offsets and transitions, not all are necessarily shown. Changes may be required in duct routings, elevation and duct shape to eliminate interference with structure and other services. All required adjustments shall be established when coordinating and field measuring the work prior to fabrication and must be provided as part of the contract and all associated costs must be considered and included.

Part 2 Products

2.1 DUCTWORK - 500 PA STATIC PRESSURE

- .1 As per Section 23 31 13 Metal Ducts Low Pressure to 500Pa.

2.2 DUCTWORK – ACOUSTICALLY LINED

- .1 Where rectangular ductwork is indicated to be acoustically insulated with flexible acoustic duct liner, shall be installed in accordance with instructions and Figures 2-22 through 2-25, SMACNA Duct Standards. Duct sizes shown are inside the duct liner.
- .2 Where round ductwork is indicated with 25mm thick flexible fibrous glass duct liner between the two ducts, the inner duct shall be suitable for the static pressure and shall be sealed airtight where it joins the adjacent ductwork.

Part 3 Execution

3.1 DUCTWORK & PLENUM INSTALLATION

- .1 Where a duct contains a fire or smoke damper, construct the duct so that the free area of the duct is maintained through the fire or smoke damper.
- .2 Where a duct is to be internally insulated, enlarge the duct so as not to reduce the duct free area.
- .3 Make the taper of diverging transitions less than 20 deg. and the taper of converging transitions less than 30 deg., in accordance with Fig. 2-9 of the SMACNA Duct Standards. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.
- .4 Make the inside radius of any rectangular duct elbow at least equal to the duct width, measured in the direction of the radius. If space conditions do not permit a full radius elbow to be installed, use square elbows with multi-blade turning vanes.
- .5 Turning vanes shall be single wall type. Vanes in galvanized sheet metal ducts shall be constructed from galvanized steel, minimum thickness 0.76 mm. Vanes shall be spaced at 40 mm centres and shall turn through 90 deg., with a radius of 50 mm. Vanes shall not include a straight trailing edge. Refer to Figs. 2-3 and 2-4 of the SMACNA Duct Standards. Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 0.86 mm thick.
- .6 For 500 Pa pressure systems, install tie rods to limit the maximum unsupported vane length to 914 mm. Refer to Fig. 2-4 of the SMACNA Duct Standards.
- .7 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs as required to suit site conditions.
- .8 Where indicated, install adjustable air turning devices, where full radius take-off fittings cannot be installed, in accordance with Fig. 2-16 of the SMACNA Duct Standards.

- .9 Adjustment shall be accessible outside the duct with lockable quadrant operator or through the grille or register with key-operated worm gear mechanism.
- .10 Cross-break or bead all metal duct panels unless otherwise noted.
- .11 Do not cross-break bottom duct panels when ductwork is handling moisture.
- .12 Support ductwork using galvanized steel straps, cadmium plated threaded rods, flat bar or angle hangers. Attachments to the structure shall be compatible with the structure and selected for the load of the ductwork. Install ductwork hangers in accordance with Section IV including Tables 4-1 through 4-3 and Figs. 4-1 through 4-9 of the SMACNA Duct Standards.
- .13 Support duct risers at their base and at each floor and at not greater than 3.7 m intervals.
- .14 Arrange ductwork and plenums so that duct and plenum mounted equipment can be easily removed.
- .15 Ducts passing through non-rated fire separations, sound insulated walls and through non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent passage of smoke and/or transmission of sound. (U.L.C. approved fire stop sealant is not a requirement). Where ducts are insulated provide a 0.61 mm [24 ga] thick galvanized steel band tightly fitted around insulation and then caulk to band.
- .16 During construction, protect openings in ductwork, from dust infiltration, by covering with polyethylene, and protect floor outlet duct openings with metal caps.
- .17 Where ductwork is required to pass through open web steel joists, coordinate with the joist fabricator before fabricating ductwork.
- .18 Where ducts penetrate roofs, install sleeves and roof curb c/w flashing and counterflashing. Pack sleeves in roof with fibreglass insulation.
- .19 Under floor ducts to be installed in accordance with Section 3.4 including Figs. 3-11 and 3-12 of the SMACNA Duct Standards.

3.2 DUCTWORK AND PLENUM CLEANING

- .1 Responsibility
 - .1 This Contractor shall be responsible for and ensure that all ductwork, installed under this contract is internally CLEAN, when handed over to the Departmental Representative. This responsibility includes the entire systems, from outdoor air intakes to air terminals and from air terminals to relief outlets. It includes all ductwork, lined and unlined, all plenums and all equipment within or connected to ducts and plenums.

- .2 The surfaces shall be considered clean when all foreign materials capable of particulating and visible to the naked eye are removed.
- .2 Installation Procedure
 - .1 All ductwork shall be wiped clean prior to installation.
 - .2 Close all dampers immediately following installation thus checking the operation and retarding movement of contaminants through the system.
 - .3 Seal all openings at the end of each day and at such other time as site conditions dictate.
 - .4 Floor openings to be capped with sheet metal or floor grilles plus 0.15 mm [6 mils] thick poly sheet.
 - .5 Other openings to be covered with 0.15 mm thick poly sheet taped so as to be air tight.
- .3 Cleaning Procedure
 - .1 On completion of the duct and plenum installation and prior to the installation of air terminals and prior to balancing of the air systems, but not until the areas are substantially clean (floors have been swept and vacuumed) and all "dirty" construction has been completed, employ an approved Cleaning Agency to vacuum clean the following:
 - .1 All plenums.
 - .2 All supply and return air ducts.
 - .3 All exhaust air ducts.
 - .4 All outdoor air ducts.
 - .5 All relief air ducts.
 - .2 All components within each system shall be thoroughly cleaned and shall include but not be limited to the following: coils, fans and motors, and air terminals.
 - .3 After the duct systems have been cleaned they should be resealed if they are not being used. Provide filter media on the return air terminals if the return air fans are run after cleaning has been completed.
 - .4 The Cleaning Agency shall perform a full inspection of the duct interior.
 - .5 Spot checks will be made by the Departmental Representative during the cleaning process to verify that the required standard is being met. When substantial performance is claimed, final spot

checks will be made to verify that the ducts are clean. If any ducts are found to be unclean, then they shall be re-cleaned.

- .6 Submit a report from the cleaning agency that certifies all specified air systems have been cleaned.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning and Special Cleaning Procedures.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 23 31 00 - Ductwork and Plenums
- .2 Section 23 33 00 - Air Duct Accessories
- .3 Section 23 33 14 - Dampers - Balancing
- .4 Section 23 33 46 - Flexible Ducts

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A480/A480M-20, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-15, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A653/A653M-19a, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Recycle or return to manufacturer for reuse of pallets, crates, padding, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 °C to plus 93 °C.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.

- .2 Radius elbows:
 - .1 Rectangular: Standard radius or short radius with single thickness turning vanes.
 - .2 Round: smooth radius, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with double thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45 degrees entry on branch
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 As indicated
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.5 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with fire-stopping manufacturer's installation requirements.
- .2 Fire stopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M-19a.
- .2 Thickness, fabrication, and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.

- .2 Hanger configuration: to SMACNA.
- .3 Hangers: Galvanized steel angle with galvanized steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GENERAL

- .1 Do work in accordance with SMACNA.
- .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.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.4 SEALING AND TAPING

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

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning and Special Cleaning Procedures.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.
- .2 Perform cleaning operations in accordance with manufacturer's recommendations.

3.6 WASTE MANAGEMENT

- .1 Separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for sheetmetal duct accessories including flexible connections, access doors, vanes, and collars.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Submit the following shop drawings:
 - .1 Duct Connectors
 - .2 Duct and plenum sealers
 - .3 Access doors in ducts and plenums.
 - .4 Instrument test ports.
 - .5 Spin-in Collars
- .4 Quality Control Check Sheets
- .5 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 – Closeout Submittals.

1.4 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .3 Quality Control Check Sheet:
 - .1 Prepare and maintain Quality Control Check Sheets.
 - .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.
 - .3 Check sheets to be filled in and submitted for review, prior to substantial completion.

- .4 Check sheets to include the following information:
 - .1 Ducts sealed all joints.
 - .2 Flexible connectors at all fan inlets, outlets and as shown.
 - .3 Wire mesh screens on all exhaust and intake locations
 - .4 Access doors at all listed locations and where shown.

Part 2 Products

2.1 GENERAL

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

2.2 DUCT CONNECTORS – VIBRATION ISOLATION

- .1 Provide flexible duct connections to provide vibration isolation at all duct and plenum connections to fan and air handling units. See Figure 2-19 SMACNA Duct Standards.
- .2 Minimum Requirements:
 - .1 Pre-assembled 75 mm minimum long flexible connection with 75 mm long, 0.62 mm galvanized steel duct connectors on each side of the flexible connection. Flexible connector - fiber glass fabric with elastomer coating.
- .3 Centrifugal fans with 900 mm diameter and larger fan wheels, use 150 mm long flexible connection.

2.3 DUCTWORK AND PLENUM SEALERS

- .1 Provide duct sealing compounds for use in fabrication of all ductwork and plenum joints.
- .2 Low Pressure Systems - SMACNA Seal Classification B. Medium and High Pressure Systems - SMACNA Seal Classification A.
- .3 Where accessible, apply sealer to inside of joints on ducts and plenums under positive pressure - e.g. on the discharge side of fans.
- .4 Apply sealer to outside of joints on ducts and plenums under negative pressure - e.g. on the suction side of fans.

2.4 SEALANT AND TAPE

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.
- .2 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.5 ACCESS DOORS IN DUCTS AND PLENUMS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 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.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.6 INSTRUMENT TEST PORTS

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.7 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to correspond with round duct standards.

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 DUCT CONNECTORS – VIBRATION ISOLATION

- .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .6 Ensure flexible duct connectors do not reduce duct free area on suction side of fans.

3.3 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.

3.4 DUCT AND PLENUM ACCESS

- .1 Locations: Provide access doors and panels as follows:
 - .1 Doors: where shown on the drawings.
 - .2 Panels:
 - .1 Every 12 m on all ductwork.
 - .2 At the base of each duct riser.
 - .3 Both sides of equipment blocking the duct e.g.
 - .1 Air flow measuring stations
 - .2 Coils
 - .4 At or to one side of other equipment in duct e.g.
 - .1 Backdraft dampers (counter weight side)
 - .2 Balance dampers serving multiple outlets/inlets
 - .3 Bearings (fans/motors)
 - .4 Control/operating dampers

- .5 Control sensors
- .6 Fire dampers (rectangular ducts and round ducts 330 mm dia. and larger - latch side)
- .7 Heat detectors (upstream from device)
- .8 Smoke detectors (upstream from device)
- .5 Panels need not be provided where access is available through a door or a register mounted on the side of the duct.
- .3 Patches:
 - .1 Where required for cleaning and where access panels are not specified, e.g. on both sides of turning vanes.
 - .4 Flexible duct - on round duct and round fire dampers up to 300 mm dia.
- .2 Seal frames airtight.
- .3 Install so as not to interfere with airflow.
- .4 Install to provide easiest possible access for service and cleaning.
- .5 Do not use sheet metal screws for attaching access panels to ductwork.
- .6 Round ducts 330 mm dia. and larger shall include a short collar for the installation of access panels.
- .7 Small rectangular ducts shall be transitioned to a minimum dimension across the duct of 330 mm for the installation of access panels.
- .8 Provide retaining chains on panels 2.1 m above floor, and higher.

3.5 INSTRUMENT TEST PORTS

- .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.

- .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.

3.6 SPIN-IN COLLARS

- .1 Provide spin-in collar and balancing damper for all round duct takeoffs from a main duct.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning and Special Cleaning Procedures.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by air duct accessory installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results for Mechanical
- .3 Section 23 05 48 Vibration and Seismic Controls

1.2 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2016, Standards Handbook.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit dimensional drawings
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, power (kW) and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.

- .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, power (W), 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 ANSI/AMCA Standard 99.

2.2 FANS GENERAL

- .1 Capacity: see equipment schedules.
- .2 Factory primed before assembly in colour standard to manufacturer.
- .3 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .4 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.3 FAN (F-9)

- .1 Aluminum housing.
- .2 Centrifugal backward inclined aluminum wheel.

- .3 Direct driven motor mounted on vibration isolation.
- .4 Down blast type.
- .5 Options: Provide roof curb. Provide bird screen.
- .6 Sound: AMCA Seal, in accordance with AMCA Publication 211-13 and AMCA Publication 311-16 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA certified ratings seal applies to sound and air performance ratings only. The sound ratings calculated per ANSI/AMCA Standard 301-14.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections.
- .2 Bearings and extension tubes to be easily accessible.
- .3 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.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning and Special Cleaning Procedures.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of Packaged Outdoor HVAC Equipment;
- .2 Fan Systems F-15, F-16, and F-17 (formerly MUA-1).

1.2 RELATED REQUIREMENTS

- .1 Division 01 – General Requirements
- .2 Section 23 05 00 – Common Work Results for Mechanical
- .3 Section 23 05 48 – Vibration and Seismic Controls
- .4 Section 23 09 01 – Controls General

1.3 REFERENCES

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
 - .1 ANSI/AHRI 210/240-16, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - .2 ANSI/AHRI 270-08, Sound Rating of Outdoor Unitary Equipment.
- .2 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2016, Standards Handbook.
- .3 CSA Group
 - .1 CAN/CSA-2.3/CAN/CSA C22.2 No.236-15 for Construction of Packaged Air Conditioner
 - .2 CSA B52-18, Mechanical Refrigeration Code.
 - .3 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-18, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Underwriters Laboratories (UL)
 - .1 UL 1995-15, Standard for Heating and Cooling Equipment.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all components and accessories, and include

- product characteristics, performance criteria, physical size, finish and limitations.
- .2 Operating and Maintenance data for insertion into the O&M manuals.
- .3 Furnish list of individual manufacturer's recommended spare parts for equipment, including:
 - .1 Bearings and seals.
 - .2 List of specialized tools necessary for adjusting, repairing or replacing.
 - .3 Spare set of filters.
 - .4 Spare set of fan motor drive belts (as applicable).
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province BC of Canada.
 - .2 Submit dimensional drawings and weights
 - .3 Drawings to indicate project layout and dimensions; indicate:
 - .1 Major components, motors, sheaves, bearings, shaft details.
 - .2 Included accessories, controls, options.
 - .3 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
 - .4 Piping, valves, fitting shipped loose showing final location in assembly.
 - .5 Control equipment shipped loose, showing final location in assembly.
 - .6 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .7 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

- .8 Fan performance curves showing point of operation, power (kW) and efficiency. Minimum performance achievable.
- .9 Details of vibration isolation.
- .10 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating. Sound rating data at point of operation.
- .11 Type of refrigerant used.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
 - .1 Submit manufacturer's field reports specified.

1.5 CLOSEOUT SUBMITTALS

- .1 Complete work in accordance with Section 01 77 00 Closeout Procedures and Section 01 78 00 Closeout Submittals.
 - .1 Provide brief description of unit, indexed, with details of function, operation, control, and service for components.
 - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.
 - .3 Maintenance material submittals and documentation.
 - .4 List of specialized tools necessary for adjusting, repairing, or replacing equipment
 - .5 Spare belts, filters, bearings, seals as applicable

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Complete work in accordance with Section 01 01 50 General Instructions (CSC).
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .4 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, power (W), efficiency, revolutions per minute, power, model, size, sound, power data and as indicated on equipment schedules.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

2.2 FAN F-15, F-16, F-17 (FORMERLY MUA-1)

- .1 General:
 - .1 Fans (Air Handling Units) shall be built to the level of quality as herein specified. Provide custom size and weight as detailed in the equipment schedules.
 - .2 Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.
 - .3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, prior to shipment.
 - .4 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

.5 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

.2 Unit Construction:

- .1 Unit casing shall be of minimum 18 gauge (1.3mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.
- .2 All high pressure [5" w.c.(1250Pa) to 9" w.c.(2250Pa)] fan sections shall be constructed of 14 gauge (2.0mm) metal. Continuous high-pressure sealant shall be provided between all panels.
- .3 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
- .4 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, and electrical control panels. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
- .5 Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and lever handles, operable from both sides for all units.
- .6 Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.
- .7 All units shall be internally insulated with 1"(25mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density insulation.
- .8 1 1/2 lb./cu.ft. (24 kg/cu.m.)insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges.
- .9 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet

- screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼" (6mm) below the floor panel.
- .10 Units mounted on roof curbs incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints are caulked.
- .3 Fans:
- .1 Centrifugal Impeller made of aluminum (AlMg3) with 7 backward curved blades and efficiency optimized circumferential diffuser. Sound optimized. Pressure orientated behaviour. Fluidic optimized inlet cone made of galvanized sheet metal. Compact, weight optimized Fan Module. Includes motor, impeller, cone, motor and cone wear plate made out of galvanized steel sheet metal and aluminum retaining profiles. Plug & Play.
- .2 Motorized Impeller statically and dynamically balanced according to DIN ISO 21940-11 at least with quality level G6.3. Energy saving EC external-rotor motor exceeds IE4 / Super Premium Efficiency.
- .3 Maintenance free ball bearings, closed on both sides with long-term lubrication. Magnets without rare earth elements.
- .4 Motor coated black and/or die casted aluminum. Protection Class IP54. 1-phase types with cable for supply and controlling and integrated passive PFC (Power Factor Correction). 100% speed controllable with integrated Motor Protection. 0-10 VDC motor speed control. Soft Start. Potential-free Alarm Contact and integrated 24V Supply for Accessories. Low noise commutation. Supply voltage shall be as per schedule.
- .4 Filters:
- .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.
- .2 For units with filter banks up to 72" (1825mm) high, the filter modules shall be designed to slide out of the unit. Side removal 1" (25mm) or 2" (50mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.
- .3 4"(100mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing

- frame. The filter media shall have a minimum efficiency of 90-95% on ASHRAE Standard 52.1-92, and a minimum of MERV 13 per ASHRAE 52.2-17. Rated U.L. Class 2.
- .4 Provide filter bank with "Dwyer 2000 magnehelic" air filter gauge complete with static pressure tips and aluminum tubing all factory installed. Filter gauge to have a range of 0 to 2" (0-500 Pa).
 - .5 Where the filter gauges are provided on outdoor units they shall be mounted inside of a weatherproof enclosure with viewing window.
- .5 Dampers:
- .1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.
 - .2 Blades shall be 18 gauge (1.3mm) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 48" (1219 mm). Damper linkage brackets shall be constructed of galvanized metal.
 - .3 Dampers shall be standard construction and include blade ends sealed with an adhesive backed foamed polyurethane gasketing. Outdoor air dampers also include an all weather PVC seal fastened with a positive lock grip and pliable overlap edge on entering air side of interlocking edges. Dampers are interlocked from the center.
 - .4 Mixing dampers shall be parallel blade type.
 - .5 Two position inlet dampers shall be parallel blade type.
 - .6 Makeup Air Inlet Damper Control shall provide a two position, normally closed electric damper operator. This damper operator shall be interlocked so that when the unit is shut down, or on a power failure, the damper shall return to the closed position.
- .6 Electrical:
- .1 Outdoor rated NEMA panel, secured to the unit face.
 - .2 Include for main disconnect, fan starters, contactors, relays, transformers, etc.
 - .3 Manufacturer shall provide a system of motor control including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, auxiliary contactors and terminals for

the connection of external control devices or relays. The manufacturer shall individually fuse all fan and branch circuits.

- .1 All control devices, including motor starters, will be capable of being interfaced with the building DDC system, which will have the ability to program remotely; start/stop functions and temperature reset functions.
- .2 Unit to be completely pre-wired to the main unit electrical panel. The Division 16 electrical contractor will bring a single 120 volt/1 phase feed to the unit mounted disconnect switch.
- .3 All electrical wiring external to the electrical/control panel to be run in EMT conduit. Wiring to be in accordance with CSA, ETL and UL requirements.
- .4 Colour code and number tag all electrical wiring.
- .4 Spare Parts:
 - .1 Provide the following spare parts:
 - .1 One set of filters (in addition to the filters used during the commissioning).
 - .2 One set of spare fan belts per unit.
- .7 Capacity: As indicated on equipment schedules.
- .8 Controls:
 - .1 The manufacturer's unit control panel shall be pre-wired with motor contactors and overloads, control transformer, high limit, burner airflow switch, terminal block and all necessary relays.
 - .2 The controls contractor shall provide all other necessary controls and damper actuators to achieve the sequence of operation as specified in Section 23 09 93 – Control Sequences.
 - .3 Provide room temperature sensor.
 - .4 Provide controls gateway for interface with the existing BMS.
Control Functions: Include unit scheduling, occupied/unoccupied mode, start-up and coast-down modes, timed override and alarm shutdown.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install as per manufacturers' instructions on roof curbs provided by manufacturer or as indicated. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge over roof drain.
- .4 The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.
 - .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 at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within [3] days of review and submit immediately to Departmental Representative.
 - .1 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
 - .2 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

3.4 SYSTEMS DEMONSTRATION

- .1 Provide systems demonstrations in accordance with Section 01 91 41 - Commissioning Training.

3.5 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.6 CLEANING

- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
- .2 Clean in accordance with Section 01 74 11 Cleaning and Special Cleaning Procedures.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 WASTE MANAGEMENT

- .1 Perform work in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by equipment installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of Packaged Outdoor HVAC Equipment;
- .2 Fan Systems F-15, F-16, and F-17 (formerly MUA-1).

1.2 RELATED REQUIREMENTS

- .1 Division 01 – General Requirements
- .2 Section 23 05 00 – Common Work Results for Mechanical

1.3 REFERENCES

- .1 Underwriters Laboratories (UL)
 - .1 UL 1995-15, Standard for Heating and Cooling Equipment.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all components and accessories, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Operating and Maintenance data for insertion into the O&M manuals.
 - .3 Furnish list of individual manufacturer's recommended spare parts for equipment, including:
 - .1 List of specialized tools necessary for adjusting, repairing or replacing.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province BC of Canada.
 - .2 Submit dimensional drawings and weights
 - .3 Drawings to indicate project layout and dimensions; indicate:
 - .1 Major components
 - .2 Included accessories, controls, options.
 - .3 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

- .4 Piping, valves, fitting shipped loose showing final location in assembly.
 - .5 Control equipment shipped loose, showing final location in assembly.
 - .6 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .6 Manufacturer's Field Reports:
 - .1 Submit manufacturer's field reports specified.

1.5 CLOSEOUT SUBMITTALS

- .1 Complete work in accordance with Section 01 77 00 Closeout Procedures and Section 01 78 00 Closeout Submittals.
 - .1 Provide brief description of unit, indexed, with details of function, operation, control, and service for components.
 - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.
 - .3 Maintenance material submittals and documentation.
 - .4 List of specialized tools necessary for adjusting, repairing, or replacing equipment

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Complete work in accordance with Section 01 01 50 General Instructions (CSC).
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .4 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, model, size, and as indicated on equipment schedules.

2.2 HEATING COIL HC-1, HC-2, HC-4

- .1 Coils shall be 5/8" O.D. and/or 1/2" O.D., constructed of Copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.
- .2 Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.
- .3 Headers with schedule 40 steel pipe connections utilize male N.P.T. up to 4"(100mm) connections.
- .4 All water coils shall be equipped with a capped vent tapping at the top of the return header or connection, and a capped drain tapping at the bottom of the supply header or connection.
- .5 Water coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.
- .6 5/8" O.D. tube diameter water coils shall be ARI Certified.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for heating coil installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install as per manufacturers' instructions and as indicated.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.
 - .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 at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within [3] days of review and submit immediately to Departmental Representative.
 - .1 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
 - .2 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

3.4 CLEANING

- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
- .2 Clean in accordance with Section 01 74 11 Cleaning.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.5 WASTE MANAGEMENT

- .1 Perform work in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by equipment installation.

END OF SECTION

Part 1 **General**

1.1 RELATED SECTIONS & SUMMARY

- .1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.
- .2 Reference to "Electrical Divisions" shall mean all sections of Division 26 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .5 The most stringent requirements of this and other electrical sections shall govern.
- .6 All work shall be in accordance with the project Drawings and Specifications and their intent complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment and wiring systems.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.
- .9 Coordinate electrical commissioning scope with the Commissioning Manager (prime contractor) and the Owner's Commissioning Authority. Participate in commissioning activities as a proactive member of the project commissioning team. See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.

1.2 REFERENCES

- .1 Install in accordance with CSA C22.1-2018 - except where specified otherwise.
- .2 Refer to CSA C22.1 Appendix A "Safety Standards for Electrical Equipment" for applicable codes and the related revisions
- .3 Refer to CSA C22.1 Pages xxix - xxxii for related 'Reference Publications'

- .4 Refer to NBCC-2015 Table 1.3.1.2 for applicable codes and the related revisions.
- .5 Comply with local electrical bulletins and by-laws relating to the Authority Having Jurisdiction.
- .6 Preferred voltage levels for AC systems: 0-50,000V in accordance with CAN3-C235 (current adopted edition)
- .7 CSA Standard Z320-11(R2016) Building Commissioning

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235-83(2015).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS in accordance with Division 01 General Requirements and Division 2 Existing Conditions.
- .3 Shop Drawings:
 - .1 Submit shop drawings, product data and samples in accordance with Division 1. The submission shall be reviewed, signed and processed as described in Division 01.
 - .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
 - .3 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
 - .4 Content
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Information shall include all scheduled data.

- .5 Advertising literature will be rejected.
- .6 The project and equipment designations shall be identified on each document.
- .7 Information shall be given in metric units.
- .8 The shop drawings/product data shall include:
 - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.
 - .2 Mounting arrangements.
 - .3 Detailed drawings of bases, supports and anchor bolts.
 - .4 Control explanation and internal wiring diagrams for packaged equipment.
 - .5 A written description of control sequences relating to the schematic diagrams.
- .4 Format
 - .1 PDF submitted via e-mail.
 - .2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.
- .5 Coordination
 - .1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.
- .6 Keep one (1) copy of shop drawings and product data, on site, available for reference.
- .7 Quality Control: in accordance with Section 01 45 00 Quality Control.
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Submit, upon completion of Work, the electrical "load balance" report.

- .8 Permits and Fees:
 - .1 Submit to electrical inspection department, local fire authorities and supply authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.
 - .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.6 **QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor licenses or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings: in accordance with Section 01 01 50 General Instructions.
 - .1 Site Meetings: as part of manufacturer's field services: schedule site visits, to review Work, at stages listed below:
 - .1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.
 - .2 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .3 During progress of Work at key schedule points as determined.
 - .4 At commissioning.
 - .5 Upon completion of Work, after cleaning is carried out.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 Health and Safety Requirements.

1.7 **DELIVERY, STORAGE AND HANDLING**

- .1 In accordance with Section 01 01 50 General Instructions (CSC).

- .2 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .3 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 Waste Management and Disposal.

1.8 SYSTEM START-UP

- .1 In accordance with Section 01 01 50 General Instructions (CSC), and as follows.
- .2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.
- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.11 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural, Structural and/or Mechanical drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 Where imperial units have been indicated in brackets [] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.12 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Departmental Representative's written approval.
- .2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference and coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference and coordination drawings to the Departmental Representative and all affected parties.
- .4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all

equipment installed can be properly, safely serviced and replaced, if and when required.

1.13 SPRINKLER-PROOF REQUIREMENTS

- .1 All equipment and wiring systems shall be sprinkler-proof standard where sprinkler fire protection systems are installed.
- .2 In rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors. Top entry to be avoided where possible
- .3 In particular all transformers, motor control and panelboard shop drawings shall be certified 'sprinkler-proof' design.

1.14 EQUIPMENT RESTRAINT

- .1 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.15 REUSED EQUIPMENT

- .1 Where existing equipment is being relocated and re-used, check and report on the condition to the Departmental Representative before reinstallation. Protect and carefully store equipment designated for reuse.

1.16 SEQUENCE OF WORK

- .1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.
- .2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- .3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.
- .4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.17 BUILDING OPERATION DURING CONSTRUCTION

- .1 In order to minimize operational difficulties for the existing building staff, the various trades must cooperate with the owner throughout the entire construction period and particularly ensure that noise is minimized.
- .2 Convenient access for the staff and public to the building must be maintained at all times. Minor inconvenience and interruption of services will be tolerated, provided advance notice is given, but the Contractor will be expected to coordinate his work, in consultation with the owner, so the operation of the facility can be maintained as nearly normal as possible.

1.18 EXISTING SERVICES

- .1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative staff to trace the originating source and points served. Obtain instructions from the Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative approval of the timing, and work to minimize any interruptions.
- .3 Shutdowns, to permit connections, to be coordinated with the maintenance staff.
- .4 In order to maintain existing services in operation, temporary relocations and wiring may be required.
- .5 Be responsible for any damages to existing systems by this work.
- .6 The interruption of utility services to permit tie-ins shall be arranged through the Departmental Representative. Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown. Service shutdowns shall only be carried out by building operations personnel and will normally be scheduled to occur during evenings or weekends. The Departmental Representative reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting-off of a service interferes with essential building operations.

1.19 SALVAGE

- .1 All conduit, wiring and equipment which becomes redundant and is no longer required due to the work in this Contract shall be completely removed.

- .2 All existing items which need to be removed, and which have a reasonable salvage value, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.
- .3 Remove from the site all redundant material not required by the Departmental Representative.

1.20 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.
- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.21 EXAMINATION

- .1 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.22 RESPONSIBILITIES

- .1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Contracting Authority during the tendering period. If clarification is not obtainable, allow for the most effective arrangement given the situation. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being

required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.

- .5 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.
- .6 Refinish damaged or marred factory finish to factory finish.
- .7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.23 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

- .1 Submit price breakdowns ten (10) days after the award of contract,
- .2 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Departmental Representative.
- .3 Mark-up information is required for change orders but is optional on the original tender price.
- .4 Progress claims will not be certified nor payment made beyond 90% of the overall electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

1.24 PROJECT CLOSE-OUT REQUIREMENTS

- .1 In accordance with Section 01 77 00 Closeout Procedures.
- .2 Refer to detailed specifications in each section for detailed requirements. Record drawings to be submitted to Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.25 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
 - .1 Commission all systems and prove out all components, interlocks and safety devices.

- .2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.
- .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Operating and Maintenance manuals completed.
 - .3 "As Built" Record Drawing ready for review.
 - .4 Systems Commissioning has been completed and has been verified by Departmental Representative.
 - .5 All demonstrations to the Departmental Representative have been completed.
- .3 Departmental Representative's Letters of Assurance will not be issued until the following requirements have been met and submitted:
 - .1 All items listed in 1.26.1 above have been completed or addressed.
 - .2 Certificate of Penetrations through separations.
 - .3 Provincial or City Electrical Inspection - Certificate of inspection.
 - .4 Seismic Engineer's letter of Assurance and final inspection report (as required).
 - .5 Certificate of Substantial Performance.
 - .6 Signed off copy of Departmental Representative's final inspection report.
 - .7 Fire alarm verification.

1.26 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26 (electrical) work have been met and verified.

Part 2 **Products**

2.1 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01 and as follows.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.
- .3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.
- .4 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, bus plugs, motor starters, for all mechanical equipment unless otherwise specified.
- .2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.
- .3 Connections shall be made with watertight flexible conduit with watertight connectors.
- .4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

2.3 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:
- .2 Nameplates:
 - .1 Lamicoid 3 mm thick plastic engraving sheet, white face, black core, self-adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.
 - .2 Nameplate Sizes:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
 - .3 Typical Labelling:
 - .1 Panelboard & CDP – 5 lines
 - .1 Line 1 – Panel/CDP designation – Size 4 lettering
 - .2 Line 2 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering
 - .3 Line 3 – Feeder: eg 4#3 – 35mm C – Size 2 lettering
 - .4 Line 4 – Origin eg: Main Elect. Room – Size 2 lettering
 - .2 Distribution Circuit Breakers – 4 lines
 - .1 Line 1 – Main Circuit Breaker – Size 4 lettering
 - .2 Line 2 – Feeder: eg 4#3 – Size 2 lettering
 - .3 Line 3 – Origin: eg K1 Sub-station – Size 2 lettering
 - .3 Label colours unless otherwise indicated:
 - .1 120/208V labels: white letters on black base.
 - .2 347/600V labels: Black letters on white base.

- .4 Wording on nameplates to be approved prior to manufacture.
 - .5 Allow for average of twenty-five (25) letters per nameplate.
 - .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .7 Terminal cabinets and pull boxes: indicate system and voltage.
 - .8 Transformers: indicate capacity, primary and secondary voltages.
- .3 Labels:
- .1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Departmental Representative before installing. Circuit numbers to agree with Record Drawings.
 - .4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.
- .2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.

- .3 Colour coding to be as follows unless otherwise specified:

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
347/600V Normal	Dark Blue		
120/208V Normal	Light Blue		
Ground	Dark Green		GR
Fire Alarm	Red		FA
Emg Voice Paging	Red	Dark Green	EP
Computer/Data	Light Green		COM
Telephone	Light Green	Black	TEL
General Intercom	Light Green	Yellow	IC
Low Level Paging	Light Green	White	PA
Building Alarm	Purple	White	BA
BAS (Digital)	White	Green	BCD
BAS (110V)	White	Black	BCH
BAS (LV)	White	Blue	BCL
PLC (Digital)	White	Brown	PLC
Low Voltage Control	White	Yellow	LVC

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.
- .3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.
- .4 Paint outdoor electrical equipment "equipment green" finish.
- .5 Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

2.8 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other Divisions.

2.9 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa [refer to structural drawings].
 - .2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 Cast-in-place type:
 - .1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel, or equivalent.
 - .2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm pipe size.
 - .3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm pipe size.
 - .2 Drilled, mechanical expansion type:
 - .1 Hilti HSL or UCAN LHL, or equivalent heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa.
 - .2 Hilti Kwik-Bolt or UCAN WED, or equivalent stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Hilti HDI or UCAN IPA, or equivalent drop-in anchor for concrete.
 - .4 Hilti or UCAN Sleeve Anchor, or equivalent. (medium and light duty) for concrete and masonry.
 - .5 Hilti ZBP or UCAN Zamac, or equivalent pin bolt (light duty) for concrete and masonry.
 - .3 Drilled, adhesive type:
 - .1 Hilti HVA or UCAN, or equivalent Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Hilti HY150 or equivalent consisting of anchor rod with a 2 part adhesive system.
 - .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.

- .4 Rod assemblies shall extend a minimum of 50 mm into the concrete slab below the housekeeping bases.
- .3 Note:
 - .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.
 - .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.
 - .3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System; or equivalent.

2.10 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.
- .3 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout.
- .5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.11 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
 - .1 Support of equipment.
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
 - .3 Earthquake restraint devices - refer also to "Seismic Restraint" sections.
 - .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be primed and undercoat painted ready for finish under the related Division.

2.12 MAINTENANCE MATERIALS AND CABINET

- .1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.

2.13 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.
- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .3 Include in the manual the following major sections:
 - .1 Title page (in plastic cover).
 - .2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.
 - .3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.
 - .4 Local source of supply for each item of equipment.
 - .5 Wiring and control diagrams.
- .4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Departmental Representative before printing.
- .5 Submit a draft copy to the Departmental Representative for review thirty (30) days prior to start-up of the systems and equipment.
- .6 Submit three (3) copies in the final approved form.

2.14 PROJECT RECORD DRAWINGS

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.
- .2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Departmental Representative on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.
- .3 At the time of "substantial performance" CAD files will be provided by the Departmental Representative. The Electrical Division shall complete the CAD Record Drawings which may include retaining the services of an approved CAD draftsman to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.
- .4 Submit the "Record Drawing" CAD files and one set of plots to the Departmental Representative prior to Total Performance of the contract.
- .5 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

Part 3

Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.
- .4 All cables and conduits to be installed concealed in finished areas.

3.4 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system.

3.5 FIELD QUALITY CONTROL

- .1 Load and Balance:
 - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .2 Conduct and pay for the following tests:
 - .1 Circuits originating from branch distribution panels.
 - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .3 Systems: fire alarm system for all affected devices.
 - .4 Main ground resistance (at all grounding locations).
 - .5 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit manufacturer's field reports.
 - .2 Furnish manufacturer's certificate or letter conforming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
 - .3 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.
 - .4 Schedule site visits to review Work.

- .5 Reports:
 - .1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.6 CLEANING

- .1 Do final cleaning in accordance with Section 01 74 11 Cleaning.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

3.7 WORKMANSHIP

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.8 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.9 PROTECTION OF ELECTRICAL EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.10 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.11 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.
- .2 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.
- .3 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.
- .4 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.
- .5 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.
- .6 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.
- .7 Provide split systems where existing cables are involved.
- .8 Provide firestopping approval certificate including a Building Code / By-Law Schedule B & C-B signed by a BC registered Professional Engineer. Submit a letter certifying that all work is complete and in accordance with this specification.

3.12 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.13 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.
- .5 Conduit sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.
- .6 Sleeve Size: 12 mm clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.14 ACCESSIBILITY AND ACCESS PANELS

- .1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.
- .2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Departmental Representative.
- .3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Secure approval in writing from the local fire authority if required.
- .4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Departmental Representative's approval.
- .5 Locate equipment and junction boxes in service areas wherever possible.

3.15 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.

- .2 CSA identification and equipment labels to be clearly visible after installation.

3.16 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.
- .3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.
- .4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Openings through structural members of the building shall not be made without the approval of the Structural Engineer.
- .6 Openings in Concrete:
 - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
 - .2 All openings shall be core drilled or diamond saw cut.
 - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .4 Refer to structural drawings for locations of steel reinforcing.
 - .5 Be responsible for repairing any damage to steel reinforcing.
- .7 Openings in building surfaces other than concrete:
 - .1 Lay out all openings required.
- .8 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.
- .9 Precast concrete items such as transformer pad bases, pull boxes and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.
- .10 Excavation and backfilling will be provided by other Divisions. This Division to superintend the work and provide all layouts and parameters.

3.17 PAINTING

- .1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.

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.
- .2 Division 01 – General Requirements
- .3 Division 02 – Existing Conditions

1.2 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with section 01 01 50 General Instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 PCB (POLYCHLORINATED BIPHENYLS)

- .1 Carefully remove any electrical items containing PCB's (e.g. luminaire ballasts) from equipment or luminaires to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

1.5 SCOPE

- .1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.
- .2 The Electrical Division to also take note of the dust containment requirements as outlined in the architectural and front end specification.
- .3 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .4 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Departmental Representative who will provide instruction.

- .5 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

1.6 SCHEDULING

- .1 In accordance with Division 01 General Requirements.

1.7 EXAMINATION

- .1 In accordance with Division 01 General Requirements.

1.8 PHASING

- .1 In accordance with Division 01 General Requirements.

1.9 PROTECTION

- .1 In accordance with Division 01 General Requirements.

Part 2 Products

2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 EXECUTION

3.1 DEMOLITION

- .1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

- .1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

3.4 DISTRIBUTION OF CIRCUITS

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical trade(s) to identify these circuits to the Departmental

Representative. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Departmental Representative before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

- .1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.
- .2 Remove all accessible (e.g. surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

3.6 EXCAVATION AND CUTTING DAMAGE

- .1 Circuits disrupted by floor cutting or drilling (i.e. buried cables) to be brought to the attention of the Departmental Representative. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to Departmental Representative.

3.7 FIRE ALARM SYSTEM

- .1 Construction/demolition activities in existing building may require that certain fire alarm devices are protected from construction dust, damage etc. Coordinate with the Departmental Representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.
- .2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The "construction" detectors to be removed and discarded at the end of the project.
- .3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification to minimize false alarms and to ensure other occupants of the building are protected.

- .4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary fire alarm devices and audible signals to suit any temporary exiting provisions.
- .5 Contractor to check in with the Departmental Representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to construction dust to be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture to be replaced immediately.
- .6 The fire alarm system is to be fully functional in the area of construction when the contractor is neither on site nor after the contractor's normal work hours (i.e. overnight, holidays, weekends).

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.
- .2 Division 01 – General Requirements.

1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated. Refer to “Site Services” Section for allowable site conduits as an alternative to steel.
- .2 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750V to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000V having a PVC jacket with FT-4 flame spread rating. Teck cable may be used for exterior condensing unit feeders, cables to be routed using existing pathways where possible.
- .3 Flexible armoured cabling (BX) shall not be used for the general wiring system other than drops from final junction boxes to recessed luminaires in concealed locations. BX cabling shall not exceed 3000m from final junction box.
- .4 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .5 Refer to Mechanical Equipment Schedule(s) for detailed responsibilities.
- .6 Non-metallic sheathed wiring is not to be used on this project.

1.3 REFERENCES

- .1 CSA International
 - .1 CAN/CSA 22.1-18, Canadian Electrical Code
 - .2 CAN/CSA C22.2 No. 0.3-09, Test methods for electrical wires and cables
 - .3 CAN/CSA C22.2 No. 65-18, Wire connectors
 - .4 CAN/CSA C22.2 No. 131-17, Type TECK 90 cable
- .2 Electrical and Electronic Manufacturers Association of Canada
 - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating)

1.4 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 Submittal Procedures.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600V RW90XLPE (X link) for the general building wiring in conduit.
- .3 Use RWU90XLPE for underground installations.
- .4 Armoured (BX) cable may only be utilized for recessed tee bar luminaire drops from final ceiling mounted outlet boxes. "Tite Bite" connectors and their counterparts of other manufacturers shall not be used. Use anti-short connectors. Cable from luminaire to luminaire is discouraged. Allow nominally 900mm [3'] extra cable looped and supported in the ceiling space to permit luminaire relocations of one tile space.
- .5 Conductors to be colour-coded. Conductors No.10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 AWG and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors not to be painted.

2.2 WIRES FOR MOTORS CONTROLLED BY PULSE WIDTH MODULATED SIGNALS

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketed.
- .3 Classified as VFD rated cable.

2.3 TECK 90 CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors: copper and sized as indicated.
- .3 Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90XLPE, 600V

- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat galvanized steel.
- .6 Overall covering: PVC jacket with FT-4 flame spread rating. PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .7 Fastenings:
 - .1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two (2) or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: Watertight approved for TECK cable

2.4 NOT USED

2.5 LOW VOLTAGE CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.
- .2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or EMT.

2.6 WIRE & BOX CONNECTORS

- .1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.
- .2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors #10 AWG or less.
- .3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors.
- .4 Clamps or connectors for armoured cable, flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install all cables and wiring.
- .2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.
- .3 Group Teck, Armoured, MI and Sheathed cables on channels wherever possible.
- .4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.

- .5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.
- .6 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.
- .7 Colour coding to be strictly in accordance with Section 26 05 00.
- .8 Provide sleeves where cables enter or exit cast concrete or masonry.
- .9 Power wiring up to and including No.6 AWG shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape, then PVC tape.
- .10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.
- .11 All branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .12 Install all control cables in conduit.
- .13 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

- .1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.
- .2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2 Transformer grounding shall comply with CSA C22.2 No.41-13(R2017).
- .3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.
- .4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 TESTING REQUIREMENTS

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

1.5 ADDITIONAL SCOPE

- .1 Refer to drawings for extent of grounding in addition to code requirements.

Part 2 Products

2.1 MATERIALS

- .1 Grounding equipment to: CSA C22.2 No.41.

2.2 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified or required to be green.

2.3 INSTALLATION GENERAL

- .1 Expand existing complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories to suit new equipment.
- .2 Provide ground wire in EMT conduits installed in grade or below slabs.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .11 Provide a bonding conductor appropriately sized within each raceway routed within the building.
- .12 All bonding and grounding connections to be compression type unless noted otherwise.
- .13 Expand existing system as required to provide complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.
- .14 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.
- .15 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.
- .16 All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.

- .17 Bond all low tension equipment with #6 AWG bonding conductor.
- .18 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

2.4 EQUIPMENT GROUNDING OR BONDING

- .1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to following list: service equipment; transformers; switchgear; duct systems; frames of motors; motor control centres; starters; UPS; control panels; building steel work; generators; elevators; distribution panels and outdoor lighting.

2.5 MECHANICAL EQUIPMENT GROUNDING

- .1 Provide a #2 ground conductor from the mechanical room ground bus to each MCC.
- .2 Provide a #6 ground conductor from the mechanical room ground bus to each VFD or VSD.
- .3 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

2.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .3 Carry out all tests required by the electrical inspector of the Authority Having Jurisdiction and provide all required reports and copied to the Departmental Representative. Include all associated costs.
- .4 Ensure test results are satisfactory before energizing the electrical system.

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.
- .2 Division 01 – General Requirements.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCES

- .1 All conduits and accessories to be manufactured and certified by the related CSA standard.

1.4 SCOPE

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.
- .3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Departmental Representative where exposed wiremold may be substituted.
- .4 Note particular requirements for routing of conduits where detailed.
- .5 Provide polypropylene pull cord in all “empty” conduits.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45.1-07 Galvanized Steel.
- .2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.1-07(2017).

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 41mm and smaller. Use two hole steel straps to conduits larger than 41mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.

- .4 10mm threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90 degree bends are required for 27mm and larger conduits.
- .3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.
- .2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" or equal.
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.
- .3 Solvent: as recommended by conduit manufacturer.

2.6 OUTLET AND CONDUIT BOXES IN GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347V outlet boxes for 347V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Bushing and connectors with nylon insulated throats.

- .8 Knock-out fillers to prevent entry of foreign materials.
- .9 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.
- .10 Double locknuts and insulated bushings on sheet metal boxes.

2.7 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. Larger 102 mm square x 54mm deep outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.
- .2 For larger boxes use GSB solid type as required.
- .3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers; or equivalent.
- .4 Lighting fixture outlets: 102 mm square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.8 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

Part 3 Execution

3.1 CONDUIT - GENERAL

- .1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
- .3 Where practical conceal conduits.
- .4 Any conduit exposed in finished areas to be free of unnecessary labels and trademarks.
- .5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.
- .6 Ensure grounding continuity in all conduit systems.
- .7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

- .8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m above the finished floor.
- .9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.
- .10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
- .11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
- .12 All branch circuit conduit, home-runs and communication/data conduits to be minimum 21 mm diameter unless otherwise indicated.
- .13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.
- .14 Conduits are not permitted in terrazzo or concrete toppings.
- .15 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.
- .16 Locate conduits more than 75mm parallel to steam or hot water lines with a minimum of 25mm at crossovers.
- .17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.
- .18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.
- .20 Damaged conduits to be repaired or replaced.
- .21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .22 Conduits shall not pass through structural members except as indicated.
- .23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.
- .24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.
- .25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

- .26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.
- .27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.
- .28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels, or equivalent.
- .29 Use "condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.
- .30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.
- .31 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m clearance.
- .3 Conduits to be run in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SURFACE RACEWAYS

- .1 Where practical provide regularly spaced device outlets and factory pre-cut raceway covers and cover plates. Field install outlets where factory installation is not possible due to delivery issues or irregularly spaced outlet requirement. In this event covers may be field cut with proprietary factory cover shear equipment with sharp blades.
- .2 Raceways shall be free of burrs inside and out.
- .3 Covers to be matching colour, smooth, free of burrs and parallel with no gaps.
- .4 Preserve and organize the space within the wireway to facilitate multiple wiring runs and future additions. In finished areas and where practical, conduit to feed the surface raceway from a box recessed behind and via grommetted openings to the back of the surface raceway. Maintain pullbox access as required by the Canadian Electrical Code.

3.4 BOXES INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .8 No sectional or handy boxes to be installed.
- .9 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .10 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- .11 Outlets installed back to back in party stud walls to be off-set by one stud space.
- .12 Refer to wiring device and communication specification sections and to architectural layouts for mounting heights of outlet boxes.
- .13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.
- .14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.
- .15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

Part 1

General

1.1 RELATED REQUIREMENTS

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 - Common Work Results for Electrical.
- .3 Section 26 28 16 - Moulded Case Circuit Breakers

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 In accordance with Section 01 01 50 General Instructions (CSC).
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2

Products

2.1

PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 208 V panelboards: bus and breakers rated for 10,000A (symmetrical) interrupting capacity or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

2.2

BREAKERS

- .1 Breakers: to Section 26 28 16 Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.

2.3

EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 5 engraved.
- .3 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 Cleaning.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Division 01 – General Requirements.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers indoors and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5-02 (R2007).
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.

- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers to have minimum 10,000A symmetrical rms interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 Cleaning.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1-18 whether indicated on not on the contract drawings.

1.2 RELATED SECTIONS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Division 01 – General Requirements.
- .3 Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA C22.2 No.4-04(2014), Enclosed Switches.
 - .2 CSA C22.2 No.39-13(2017), Fuseholder Assemblies.

1.4 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 Health and Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.6 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00 Common Work Results for Electrical, and Section 01 33 00 Submittal Procedures.

Part 2 Products

2.1 DISCONNECT EQUIPMENT

- .1 “Heavy Duty” class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA enclosure.
- .4 Provision for padlocking in off switch position.

- .5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Provide an auxiliary switch with dry contacts on all elevator disconnects and as required by the Elevator Code. Review elevator shop drawings to confirm any additional requirements.
- .10 All outdoor disconnect switches shall be rated for NEMA 4X.

2.2 EQUIPMENT IDENTIFICATION

- .1 Indicate name of load controlled on size 4 name plate to Section 26 05 00 Common Work Results for Electrical.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses where indicated or required.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated or not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

- .1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Departmental Representative has given a special pre-approved circumstance.

END OF SECTION

APPENDIX-A

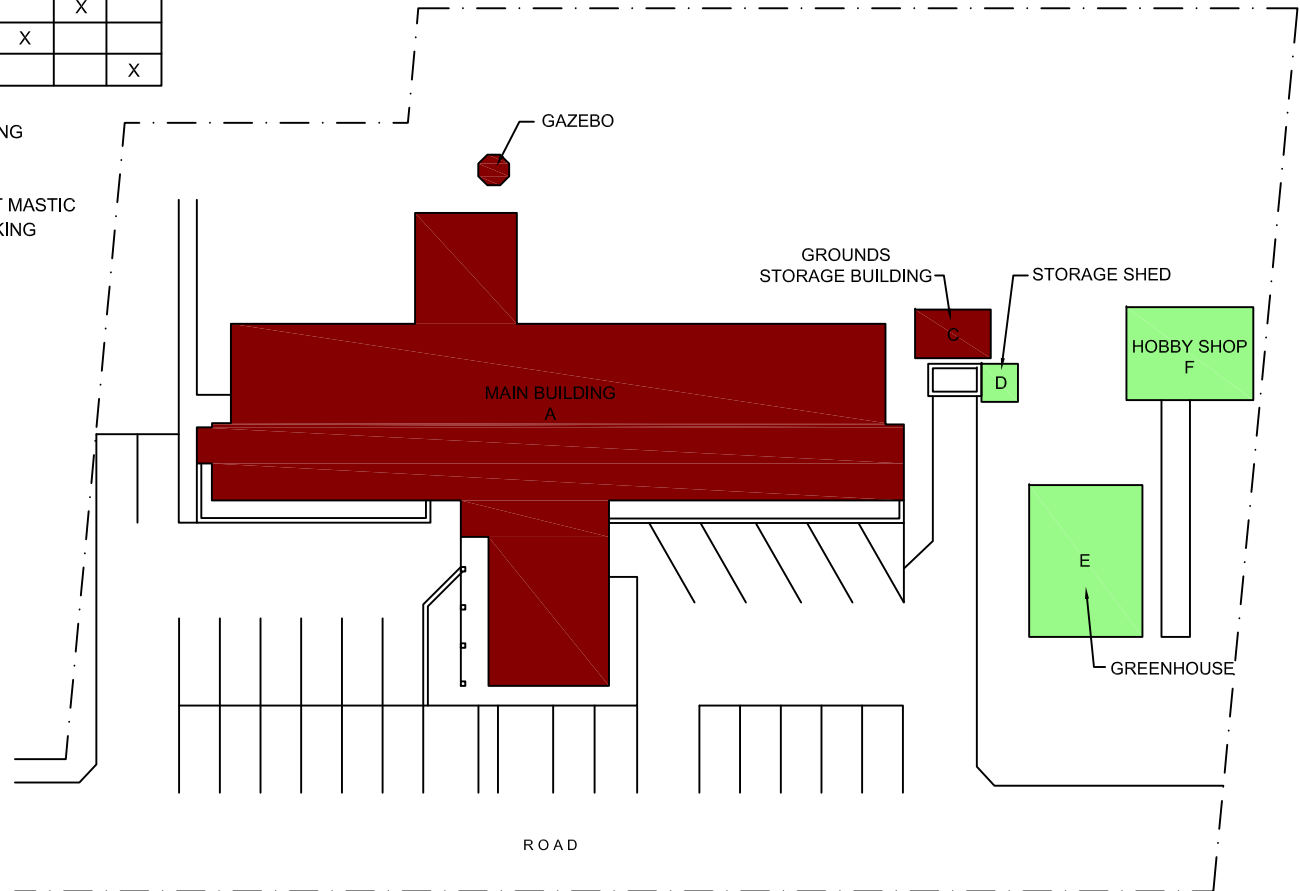
HAZARDOUS BUILDINGS MATERIALS ASSESSMENT

**SUMMARY OF ASBESTOS-CONTAINING MATERIALS (ACMs)/
LEAD-CONTAINING PAINTS (LCPs) AND LOCATIONS**

BUILDING NAME	WPC	PS	RS	PVM	WFC	LCP	PLCP
MAIN BUILDING (A)	X	X	X	X		X	
GROUNDS STORAGE BUILDING (C)					X		
GAZEBO							X



1. WPC – ASBESTOS-CONTAINING WINDOW PANE CAULKING
2. PS – ASBESTOS-CONTAINING PIPE SEALANT
3. RS – ASBESTOS-CONTAINING ROOF SEALANT
4. PVM – PRESUMED ASBESTOS-CONTAINING ROOF VENT MASTIC
5. WFC – ASBESTOS-CONTAINING WINDOW FRAME CAULKING
6. PLCP – PRESUMED LEAD-CONTAINING PAINT



LEGEND

- ASSESSED - ACMs AND/OR LCPs PRESENT
- ASSESSED - NO ACMs OR LCPs IDENTIFIED

NOTE:- SEE HAZARDOUS BUILDING MATERIALS MANAGEMENT PLAN FOR MORE INFORMATION.

ACM AND LCP SITE PLAN

CSC CHILLIWACK COMMUNITY CORRECTIONAL CENTRE
45914 ROWAT AVENUE, CHILLIWACK, BC

Reference.:

MARCH, 2018

Dwg. No.:

1

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

Appendix 5.1 FINDINGS AND RECOMMENDATIONS— BUILDING A—MAIN BUILDING

Building A—Main Building (subject building) was reportedly constructed in 1989 and has been assigned Real Property ID #23. The typical structural components and finishes associated with this two storey building consist of exterior stucco and cement panel siding; ceiling tiles and drywall ceilings; ceramic tile, wood and drywall interior walls; an upper peaked asphalt shingle roof and two lower asphalt membrane rooves; and, concrete, ceramic tile, hardwood, vinyl floor tile and vinyl sheet flooring.

It should be noted that the following building location was not accessed during the project for the reasons indicated:

- Roof (sloped roof which could not be safely accessed without fall protection)

The results of the assessment for each of the considered hazardous materials within the subject building are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

5.1-1 ASBESTOS

Stantec identified and sampled various suspected ACMs. The samples collected were submitted to EMSL for analysis of asbestos content and nature.

A summary of the materials sampled as part of the assessment, along with the sample locations and analytical results is presented in Table 5.1-1, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted as part of this assessment is attached at the end of this Appendix.

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**

Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-VSF-01	Vinyl sheet flooring, light blue with pink and white smears	Room 226, storage, patch	None Detected
A-VSF-02	Vinyl sheet flooring, beige with smudges	Room 221, storage	None Detected

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**

Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-VSF-03	Vinyl sheet flooring, blue with grey specks and sparkles	Room 220, washroom	None Detected
A-VSF-04	Vinyl sheet flooring, beige, purple, and pink pebble pattern	Room 218, storage room	None Detected
A-VSF-05	Vinyl sheet flooring, beige and grey pebble pattern	Room 216, bedroom (1)	None Detected
A-VSF-06	Vinyl sheet flooring, grey and blue pebble pattern	Room 200A, stairwell north	None Detected
A-VSF-07	Vinyl sheet flooring, grey and white pebble pattern	Room 134, storage room	None Detected
A-VSF-08	Vinyl sheet flooring, grey pebble pattern	Patch under door from room 100D, lower main corridor to room 100C, south exit vestibule	None Detected
A-VSF-09	Vinyl sheet flooring, white and grey speckles	Room 126, storage room	None Detected
A-VSF-10	Vinyl sheet flooring, light grey with white and dark streaks	LR living room near room ELEC, electrical closet and room 100F, lower west corridor	None Detected
A-VFT-01	Vinyl floor tile, 12"x12" light grey with smears	Room 105, file storage	None Detected
A-DJC-01A	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room 127, LAN room perimeter wall beside room 126, storage room	None Detected
A-DJC-01B	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room 124, food storage partition wall beside room 125, janitors closet	None Detected
A-DJC-01C	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room 130, mechanical room partition wall beside room 100d lower main corridor	None Detected
A-DJC-01D	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room ELEC, electrical closet partition wall	None Detected
A-DJC-01E	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room 118, dining room perimeter wall near door	None Detected
A-DJC-01F	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room 100G, lower north corridor outside room 100A, stairwell north	None Detected
A-DJC-01G	Drywall joint compound applied to drywall walls and ceilings throughout the first floor	Room 102, waiting room partition wall beside room 130, mechanical room	None Detected

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**

Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-DJC-02A	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 225, bedroom (1) perimeter wall	None Detected
A-DJC-02B	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 221, storage partition wall beside room 220, washroom	None Detected
A-DJC-02C	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 200A, stairwell north beside railing	None Detected
A-DJC-02D	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 219, janitors closet partition wall beside room 217, bedroom (1)	None Detected
A-DJC-02E	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 204, bedroom (2) partition wall beside room 202, bedroom (2)	None Detected
A-DJC-02F	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 200C, upper main corridor outside room 205, bedroom (2)	None Detected
A-DJC-02G	Drywall joint compound applied to drywall walls and ceilings throughout the second floor	Room 200A, stairwell north, partition wall to room 200d, upper north corridor	None Detected
A-CT-01A	Suspended ceiling tile, 2'x4', standard fissure and pinhole pattern	Room 124, food storage	None Detected
A-CT-01B	Suspended ceiling tile, 2'x4', standard fissure and pinhole pattern	Room 124, food storage	None Detected
A-CT-01C	Suspended ceiling tile, 2'x4', standard fissure and pinhole pattern	Room 124, food storage	None Detected
A-CT-02A	Suspended ceiling tile, 2'x4', directional fissure and pinhole pattern	Room 124, food storage	None Detected
A-CT-02B	Suspended ceiling tile, 2'x4', directional fissure and pinhole pattern	Room 124, food storage	None Detected
A-CT-02C	Suspended ceiling tile, 2'x4', directional fissure and pinhole pattern	Room 124, food storage	None Detected
A-CT-03A	Ceiling tile, 1'x1', directional fissure and pinhole pattern	Room 118, dining room	None Detected

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**

Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-CT-03B	Ceiling tile, 1'x1', directional fissure and pinhole pattern	Room 118, dining room	None Detected
A-CT-03C	Ceiling tile, 1'x1', directional fissure and pinhole pattern	Room 118, dining room	None Detected
A-CT-04A	Suspended ceiling tile, 2'x4', white, shallow fissure pattern	Room 100G, lower north corridor	None Detected
A-CT-04B	Suspended ceiling tile, 2'x4', white, shallow fissure pattern	Room 100G, lower north corridor	None Detected
A-CT-04C	Suspended ceiling tile, 2'x4', white, shallow fissure pattern	Room 100G, lower north corridor	None Detected
A-CT-05A	Suspended ceiling tile, 2'x4', white pinhole pattern	Room 105, file storage	None Detected
A-CT-05B	Suspended ceiling tile, 2'x4', white pinhole pattern	Room 105, file storage	None Detected
A-CT-05C	Suspended ceiling tile, 2'x4', white pinhole pattern	Room 105, file storage	None Detected
A-CTG-01A	Ceiling tile glue applied to back of 1'x1' ceiling tiles	Room 100H, lower east corridor	None Detected
A-CTG-01B	Ceiling tile glue applied to back of 1'x1' ceiling tiles	Room 100H, lower east corridor	None Detected
A-CTG-01C	Ceiling tile glue applied to back of 1'x1' ceiling tiles	Room 100H, lower east corridor	None Detected
A-WPC-01A	Window pane caulking, black applied to windows throughout	Room 222, bedroom (1)	0.63% Chrysotile
A-WPC-01B	Window pane caulking, black applied to windows throughout	Room 214, library/tv	Positive Stop (Not Analyzed)
A-WPC-01C	Window pane caulking, black applied to windows throughout	Room 216, bedroom (1)	Positive Stop (Not Analyzed)
A-WPC-02A	Window pane caulking, white applied to windows throughout	Room 115, office	None Detected
A-WPC-02B	Window pane caulking, white applied to windows throughout	Room 115, office	None Detected
A-WPC-02C	Window pane caulking, white applied to windows throughout	Room 115, office	None Detected
A-ARS-01A	Asphalt roof Shingle	Roof, west wing outside room 210	None Detected
A-ARS-01B	Asphalt roof Shingle	Roof, west wing outside room 210	None Detected
A-ARS-01C	Asphalt roof Shingle	Roof, west wing outside room 210	None Detected
A-CP-01	Cement panel	Base of exterior south wall	None Detected

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**

Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-DM-01A	Duct mastic, white applied to seams of round HVAC ducting	Round roof duct, west wing roof	None Detected
A-DM-01B	Duct mastic, white applied to seams of round HVAC ducting	Round roof duct, west wing roof	None Detected
A-DM-01C	Duct mastic, white applied to seams of round HVAC ducting	Round roof duct, west wing roof	None Detected
A-DM-02A	Duct mastic, grey applied to seams of round HVAC ducting	Round roof duct, west wing roof	None Detected
A-DM-02B	Duct mastic, grey applied to seams of round HVAC ducting	Round roof duct, west wing roof	None Detected
A-DM-02C	Duct mastic, grey applied to seams of round HVAC ducting	Round roof duct, west wing roof	None Detected
A-DM-03A	Duct mastic, grey applied to seams of square HVAC ducting	Square roof duct, west wing roof	None Detected
A-DM-03B	Duct mastic, grey applied to seams of square HVAC ducting	Square roof duct, west wing roof	None Detected
A-DM-03C	Duct mastic, grey applied to seams of square HVAC ducting	Square roof duct, west wing roof	None Detected
A-FM-01A	White roof flashing mastic	South edge of west wing roof	<0.25% Chrysotile (see 5.1-1.1)
A-FM-01B	White roof flashing mastic	South edge of west wing roof	0.48% Chrysotile (see 5.1-1.1)
A-FM-01C	White roof flashing mastic	South edge of west wing roof	0.26% Chrysotile (see 5.1-1.1)
A-FS-01A	Fire stopper, grey applied to sprinkler lines	Room 226, storage, floor penetration	None Detected
A-FS-01B	Fire stopper, grey applied to sprinkler lines	Room 226, storage, floor penetration	None Detected
A-FS-01C	Fire stopper, grey applied to sprinkler lines	Room 226, storage, floor penetration	None Detected
A-FS-02A	Fire stopper, grey applied to sprinkler lines	Room 200D, upper north corridor, wall penetration near ceiling	None Detected
A-FS-02B	Fire stopper, grey applied to sprinkler lines	Room 200D, upper north corridor, wall penetration near ceiling	None Detected
A-FS-02C	Fire stopper, grey applied to sprinkler lines	Room 200D, upper north corridor, wall penetration near ceiling	None Detected
A-FS-03A	Fire stopper, red applied to sprinkler lines	Room 220, washroom, wall penetration near ceiling	None Detected

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**

Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-FS-03B	Fire stopper, red applied to sprinkler lines	Room 220, washroom, wall penetration near ceiling	None Detected
A-FS-03C	Fire stopper, red applied to sprinkler lines	Room 220, washroom, wall penetration near ceiling	None Detected
A-PP-01A	Penetration putty, beige applied to lead electrical penetrations	West wing roof, west edge	None Detected
A-PP-01B	Penetration putty, beige applied to lead electrical penetrations	West wing roof, centre	None Detected
A-PP-01C	Penetration putty, beige applied to lead electrical penetrations	West wing roof, centre	None Detected
A-PS-01A	Pipe sealant, white applied to threads of sprinkler pipes fittings throughout	Room 212, washroom	None Detected
A-PS-01B	Pipe sealant, white applied to threads of sprinkler pipes fittings throughout	Room 201, washroom	None Detected
A-PS-01C	Pipe sealant, white applied to threads of sprinkler pipes fittings throughout	Room 130, mechanical room	None Detected
A-PS-02A	Pipe sealant, blue applied to threads of sprinkler pipes fittings throughout	Room 125, janitors closet	0.52% Anthophyllite
A-PS-02B	Pipe sealant, blue applied to threads of sprinkler pipes fittings throughout	Room 123, storage	Positive Stop (Not Analyzed)
A-PS-02C	Pipe sealant, blue applied to threads of sprinkler pipes fittings throughout	Room 134, storage room	Positive Stop (Not Analyzed)
A-RF-01A	Black roof felt	West wing roof	None Detected
A-RF-01B	Black roof felt	West wing roof	None Detected
A-RF-01C	Black roof felt	West wing roof	None Detected
A-RM-01A	Asphalt roof membrane	West wing roof, east edge	None Detected
A-RM-01B	Asphalt roof membrane	West wing roof, centre	None Detected
A-RM-01C	Asphalt roof membrane	West wing roof	None Detected
A-RS-01A	Roof sealant, white/grey on seams of MUA unit	West wing roof	3.1% Chrysotile
A-RS-01B	Roof sealant, white/grey on seams of MUA unit	West wing roof	Positive Stop (Not Analyzed)

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-1 Suspected ACM Sample Collection and Analysis Summary
Building A—Main Building**


Sample Number	Material Description	Sample Location	Result (%/type asbestos)
A-RS-01C	Roof sealant, white/grey on seams of MUA unit	West wing roof	Positive Stop (Not Analyzed)
A-SC-01A	Seam caulking, cream applied to exterior vents	North wall outside room 100H, lower east corridor	None Detected
A-SC-01B	Seam caulking, cream applied to exterior vents	North wall outside room 100H, lower east corridor	None Detected
A-SC-01C	Seam caulking, cream applied to exterior vents	West wall outside room 103, general office	None Detected
A-SC-02A	Seam caulking, grey applied to exterior walls of sprinkler room	Exterior room SPR, sprinkler room	None Detected
A-SC-02B	Seam caulking, grey applied to exterior walls of sprinkler room	Exterior room SPR, sprinkler room	None Detected
A-SC-02C	Seam caulking, grey applied to exterior walls of sprinkler room	Exterior room SPR, sprinkler room	None Detected
A-ST-01A	Light yellow stucco applied to exterior walls	Room SPR, sprinkler room, back wall	None Detected
A-ST-01B	Light yellow stucco applied to exterior walls	Exterior southeast corner	None Detected
A-ST-01C	Light yellow stucco applied to exterior walls	Exterior, southeast wall	None Detected
A-ST-01D	Light yellow stucco applied to exterior walls	Exterior east wing, north wall	None Detected
A-ST-01E	Light yellow stucco applied to exterior walls	Exterior northwest corner	None Detected
A-ST-01F	Light yellow stucco applied to exterior walls	Exterior west wing, west wall	None Detected
A-ST-01G	Light yellow stucco applied to exterior walls	Exterior southwest corner	None Detected
NOTE: Bold, highlighted text indicates confirmed ACM			

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of suspected ACM sample analytical results, the materials presented in Table 5.1-2, below were identified as ACMs or presumed ACMs (PACMs).

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-2 Summary of Identified ACMs
Building A—Main Building**

Identified ACM Description and Condition Information		Photo
Black window pane caulking applied to windows throughout.		
Friability	Non-friable	
Condition	Good	
Total Quantity	Approximately 32 4'x4' windows	
Content	0.63% Chrysotile	
Blue pipe sealant applied to threads of sprinkler line fittings throughout.		
Friability	Non-friable	
Condition	Good	
Total Quantity	Sprinkler line fittings throughout	
Content	0.52% Chrysotile	
White/grey roof sealant applied to seams of make-up air unit on the lower west roof.		
Friability	Non-friable	
Condition	Good	
Total Quantity	Approximately 5 linear meters	
Content	3.1% Chrysotile	
Mastic applied to roof vents on the upper peaked roof.		
Friability	Non-friable	
Condition	Good	
Total Quantity	Approximately 5 vents	
Content	PACM (sloped roof which could not be safely accessed without fall protection)	

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

5.1-1.1 Materials with less than 0.5% Asbestos

It should be noted that less than 0.5% chrysotile asbestos was detected in the three samples of roof flashing mastic collected from the subject building (less than 0.25%, 0.48% and 0.26%, respectively). Given the limited extent of this non-friable material and its apparent consistent application (visual similarity throughout), the sample results are considered representative of the entire application. Given the analytical results, this material would not be considered ACM, as the asbestos content is less than 0.5%, and there would not be a reasonable chance that asbestos fibres would be released when the material is disturbed.

5.1-1.2 Potential Asbestos-Containing Vermiculite Insulation

As part of the assessment, Stantec assessed the subject building for areas where vermiculite insulation, a potential ACM, would likely be present. This included making note of attic spaces, floor cavities and masonry block or brick walls, which are typical areas where vermiculite is found. The following observations we made regarding areas where vermiculite is potentially present:

- No vermiculite was present within the attic space
- No other locations that may potentially contain vermiculite (that could not otherwise be assessed) were observed

5.1-2 LEAD

Lead is expected to be present in the following:

- Lead-acid batteries used in emergency lighting
- Older electrical wiring materials and sheathing
- Solder used on domestic water lines
- Solder used in bell fittings of cast iron pipes and in electrical equipment
- Ceramic tile glaze
- Vent and pipe flashings

In addition to the above, Stantec collected paint chip samples from predominant suspected LCP applications within the subject building. A summary of the sample types, locations and analytical results is presented in Table 5.1-3, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-3 Suspected LCP Sample Collection and Analysis Summary
Building A—Main Building**




Sample No.	Sample Colour/Substrate	Sample Location	Lab Result (ppm)
A-P-01	Grey on drywall	Room 226, storage, wall	<85
A-P-02	Beige on wood fence and metal flashing	Fence around west lower roof	380
A-P-03	Pink on drywall	Room 124, food storage, wall	370
A-P-04	Grey on concrete floor	Room 124, food storage, floor	2,300
A-P-05	Off-white on drywall	Room 130, mechanical room, wall	<130
A-P-06	Dark blue on wood trim and metal doors	Room 200B, stairwell south, door frame to room 200C, upper main corridor	980
A-P-07	Light blue on wood trim and metal doors	Room 125, janitors closet, door frame	680
A-P-08	Dark brown on wood trim	Exterior post, south end of building	660
A-P-09	Light brown on metal door and frame	Exterior south exit door	<100
A-P-10	Yellow on concrete	Exterior curb outside room 100E, west exit vestibule	<88
NOTE: Bold, highlighted text indicates confirmed LCP			

Based on our observations and on our interpretations of suspected LCP sample analytical results, the paints presented in Table 5.1-4, below were identified as LCPs:

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018


**Table 5.1-4 Summary of Identified LCPs
Building A—Main Building**

Identified LCP Description		Photo
Paint colour	Grey	
Substrate	Concrete	
Location/approx. extent	Floor	
Lead content	2,300 ppm	
Condition	Good in general, worn in localized areas	
Paint colour	Dark blue	
Substrate	Wood and metal	
Location/approx. extent	Second floor trim and doors	
Lead content	980 ppm	
Condition	Good	
Paint colour	Light blue	
Substrate	Wood and metal	
Location/approx. extent	First floor trim and doors	
Lead content	680 ppm	
Condition	Good	

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-4 Summary of Identified LCPs
Building A—Main Building**

Identified LCP Description		Photo
Paint colour	Dark brown	
Substrate	Wood	
Location/approx. extent	Exterior trim	
Lead content	660 ppm	
Condition	Good	

5.1-3 POLYCHLORINATED BIPHENYLS

Based on the construction date of the subject building, PCB-containing items are not anticipated to be present.

5.1-4 MERCURY

Mercury vapour is present in the light tubes/bulbs in the approximately 130 fluorescent light fixtures observed.

Mercury is present in the switch in one thermostat observed in room LR, living room, as indicated on the floor plan drawing.

Mercury may also be present in paints and adhesives.



5.1-5 MOULD

The observations pertaining to mould and/or moisture that were made during this assessment are summarized in 5.1-5, below.

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

**Table 5.1-5 Mould/Moisture Observations Summary—January 31, 2018
Building A—Main Building**

Building Area	Observation	Suspected Source of Moisture	Photo
Various locations throughout first floor	Moisture-stained ceiling tiles	Pipe leaks, HVAC condensation tray overflow	
Room 125, janitor's closet, wall above slop sink	Moisture-damaged drywall	Slop sink tap and/or pipes	

5.1-6 OZONE-DEPLETING SUBSTANCES

The following equipment was identified by labels to be ODS-containing:

- Five Mitsubishi air conditioning units servicing the first-floor offices (18 lbs. total of R-22)
- One Heatcraft walk-in cooler condenser (7 lbs. of R-22)

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

The locations of the confirmed ODS-containing units are indicated in the floor plan drawings attached to this appendix.

5.1-7 SILICA

Silica is expected to be present in the following, which were observed in various locations throughout:

- Cement products such as:
 - Concrete foundation
 - Ceramic tiles and associated grouts/mortar
 - Cement panel
- Gypsum board and associated wall/ceiling finish materials
- Suspended ceiling tiles
- Stucco
- Asphalt and asphalt products containing rock or stone (e.g. roof shingles and membrane)

5.1-8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 6.0 of the main body of this report for applicable material-by-material general recommendations.

Additional building-specific recommendations to be considered are provided below.

5.1-8.1 Asbestos

Prior to renovation and/or demolition activities that would disturb them, undertake testing of PACMs that may be impacted to determine their asbestos content. Confirmed ACMs should be handled accordingly.

5.1-8.2 Mould

Documents published by Health Canada, Ontario Ministry of Health, AIHA, ACGIH and others, provide guidance for interpreting the results of mold investigations. The Health Canada Guide states that:

“...current knowledge supports the need to prevent damp conditions and mold growth and to remediate any fungal contamination in buildings.”

To this end, Stantec recommends the following course of action within the subject building:

- Remove and replace moisture-stained ceiling tiles with new tiles. If staining re-appears on the new tiles, the source of moisture should be identified and corrected



HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix 5.1 Findings and Recommendations—Building A—Main Building
March 2018

- This work can be conducted by regular facility maintenance staff, if conducted prior to the onset of mould growth
- Monitor water damaged drywall in room 125 janitor’s closet. If damage worsens or if active moisture is observed, the source of moisture should be identified and corrected, and the impacted building material should be removed
 - This work—both monitoring and removal—can be conducted by regular facility maintenance staff, if conducted prior to the onset of mould growth

APPENDIX-B

PRELIMINARY HAZARD ASSESSMENT FORM



PRELIMINARY HAZARD ASSESSMENT FORM

Project Number:	R.097948.001
Location:	Chilliwack Community Centre, 45914 Rowat Avenue, Chilliwack, B.C.
Date:	2020-05-25
Name of Departmental Representative:	Jimmy Ng, PSPC
Name of Client:	Correctional Service Canada
Name of Client Project Co-ordinator	Ray Halvorson PH: (604) - 615-0297

Site Specific Orientation Provided at Project Location **Yes** **No**

Notice of Project Required **Yes** **No**

NOTE:

PWGSC requires "**A Notice of Project**" for all construction work related activities.

NOTE:

OHS law is made up of many municipal, provincial, and federal acts, regulations, bylaws and codes. There are also many other pieces of legislation in British Columbia that impose OHS obligations.

Important Notice: This hazard assessment has been prepared by PWGSC for its own project planning process, and to inform the Contractor of actual and potential hazards that may be encountered in performance of the work. PWGSC does not warrant the completeness or adequacy of this hazard assessment for the project and the paramount responsibility for project hazard assessment rests with the Contractor.

TYPES OF HAZARDS TO CONSIDER	Potential Risk for:				COMMENTS
	PWGSC, Other Government Departments, and Inmates		General Public or other provincial contractors		
Examples: Chemical, Biological, Natural, Physical, Psychosocial, and Ergonomic					Note: When thinking about this pre-construction hazard assessment, remember a hazard is anything that may cause harm, such as chemicals, electricity, working from heights, etc; the risk is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.
Listed below are common construction related hazards. Your project may include pre-existing hazards that are not listed. Contact the Regional Construction Safety Coordinator for assistance should this issue arise.	Yes	No	Yes	No	

Typical Construction Hazards					Comments
Concealed/Buried Services (electrical, gas, water, sewer etc)	Yes		Yes		
Slip Hazards or Unsound Footing	Yes		Yes		
Working at Heights (2.4m)	Yes		Yes		In a federal institution the fall protection requirement is 2.4m NOT 3m as per WBC OHSR
Working Over or Around Water		No		No	
Heavy overhead lifting operations, mobile cranes etc.	Yes		Yes		



PRELIMINARY HAZARD ASSESSMENT FORM

Marine and/or Vehicular Traffic (site vehicles, public vehicles, etc.)	Yes		Yes		
Fire and Explosion Hazards	Yes		Yes		
High Noise Levels	Yes		Yes		
Excavations		No		No	
Blasting		No		No	
Construction Equipment	Yes		Yes		
Pedestrian Traffic (site personnel, tenants, visitors, public)	Yes		Yes		
Multiple Employer Worksite	Yes		Yes		Contractor working in an occupied federal employee environment.

Electrical Hazards					Comments
Contact With Overhead Wires	Yes		Yes		
Live Electrical Systems or Equipment	Yes		Yes		
Other: Arc Flash	Yes		Yes		

Physical Hazards					Comments
Equipment Slippage Due To Slopes/Ground Conditions	Yes		Yes		
Earthquake	Yes		Yes		
Tsunami		No		No	
Avalanche		No		No	
Forest Fires		No		No	
Fire and Explosion Hazards	Yes		Yes		
Working in Isolation		No		No	
Working Alone		No		No	
Violence in the Workplace	Yes		Yes		
High Noise Levels	Yes		Yes		
Inclement weather	Yes		Yes		High winds and snow
High Pressure Systems		No		No	
Other:					

Hazardous Work Environments					Comments
Confined Spaces / Enclosed Spaces	n/a		n/a		
Suspended / Mobile Work Platforms	Yes		Yes		
Other:					

Biological Hazards					Comments
Mould Proliferations	Yes		Yes		Reference: CCC Hazardous Building Materials Assessments, Stantec Dated March 2018



PRELIMINARY HAZARD ASSESSMENT FORM

Accumulation of Bird or Bat Guano		No		No	
Bacteria / Legionella in Cooling Towers / Process Water		No		No	
Rodent / Insect Infestation		No		No	
Poisonous Plants		No		No	
Sharp or Potentially Infectious Objects in Wastes	Yes		Yes		
Wildlife		No		No	
Other					
COVID 19	Yes		Yes		Reference: CSA National COVID 19 Standardized Protocol, Province of B.C. Construction - Business PHO, and CSC Kent Institution COVID 19 Procedures

Chemical Hazards					Comments
Asbestos Materials on Site	Yes		Yes		Reference: CCC Hazardous Building Materials Assessments, Stantec Dated March 2018
Designated Substance Present		No		No	If "yes" a pre-project designated substance survey report is required.
Chemicals Used in work (see comments)		No		No	WHMIS 2015 SDS for all products being used
Lead in paint	Yes		Yes		Reference: CCC Hazardous Building Materials Assessments, Stantec Dated March 2018
Mercury in Thermostats or Switches (see comments)	TBD		TBD		Reference: CCC Hazardous Building Materials Assessments, Stantec Dated March 2018
Application of Chemicals or Pesticides		No		No	
PCB Liquids in Electrical Equipment (see comments)	TBD		TBD		Reference: CCCHazardous Building Materials Assessments, Stantec Dated March 2018
Radioactive Materials in Equipment		No		No	
Other:					

Contaminated Sites Hazards					Comments
Hazardous Waste		No		No	
Hydrocarbons		No		No	
Metals		No		No	
Other:					
Security Hazards					Comments
Risk of Assault	Yes		Yes		
Other:					



PRELIMINARY HAZARD ASSESSMENT FORM

Other Hazards					Comments

Other Compliance and Permit Requirements ¹	YES	NO	Notes / Comments ²
Is a Building Permit required?		n/a	
Is a Electrical permit required?	Yes		Contractor to secure permits
Is a Plumbing Permit required?		n/a	
Is a Sewage Permit required?		n/a	
Is a Dumping Permit required?	TBD		Contractor shall follow federal/provincial regulations
Is a Hot Work Permit required?	Yes		Mandatory for any hot work process
Is a Permit to Work required?		No	
Is a Confined Space Entry Permit required?	Yes		Mandatory for all Confined Spaces
Is a Confined Space Entry Log required?	Yes		Mandatory for all Confined Spaces
Discharge Approval for treated water required?		n/a	

Notes:

- (1) Does not relieve Contractor from complying with all applicable federal, provincial, and municipal laws and regulations.
- (2) TBD means To Be Determined by Contractor.

Prime Contractor Acknowledgement: We confirm receipt and review of this Preliminary Project Hazard Assessment and acknowledge our responsibility for conducting our own assessment of project hazards, and taking all necessary protective measures (which may exceed those cited herein) for performance of the work.			
Contractor Name			
Signatory for Contractor		Date Signed	
RETURN EXECUTED DOCUMENT TO PWGSC DEPARTMENTAL REPRESENTATIVE PRIOR TO ANY WORK COMMENCING			