# Public Works and Government Services Canada

Requisition No. _____

DRAWINGS & SPECIFICATIONS
Issued For Tender

Matsqui Institution
33344 king Road
Abbotsford, BC
R.113047.001

**APPROVED BY:**

Mehrabadi, Behzad
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Regional Manager, AES _____ Date

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Construction Safety Coordinator _____ Date

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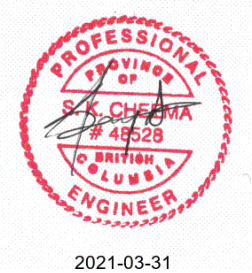
Project Manager _____ Date

**Real Property Services Branch, Professional and Technical Services, Pacific Region**
**Room 219 - 800 Burrard Street, Vancouver, B.C. V6Z 0B9**

## CONSULTANTS – SEAL & SIGNATURE

| **Discipline** | **Seal / Signature / Date** |
|---|---|
| Mechanical (Prime) |   |
| Architectural |   |
| Structural |   |

Electrical




2021-03-31

END OF SECTION

MECHANICAL DRAWINGS



**END OF LIST OF DRAWING**

**END OF SECTION**

## Part 1 General

### 1.1 SUMMARY OF WORK

Work covered by Contract Documents covers the following works at CER room, Matsqui Institution at Abbotsford, B.C.:

.1 At all time during demolition work, new installations and commissioning, cooling and appropriate humidity ratio shall be provided to the CER to maintain the room temperature at minimum 18 °C and maximum at 27°C. The minimum dew point temperature would be -9°C and maximum dewpoint will be 15°C respectively to the room dry bulb temperature of 18 °C and 27 °C. The room relative humidity shall be less than 60% in all time per ASHRAE TC 9.9 recommendations. As a standard approach, room can be maintained at 24 °C and a relative humidity (RH) range of 35% to 55%. Provide for temporary cooling or use existing cooling units at your discretion. If existing units are used, they should be demolished once the new system is installed, tested and commissioned for 15 days. CER will not be left without cooling at any time.

.2 Complete testing, balancing, start-up and commissioning of the CER cooling and humidification system.

.3 HVAC System Upgrade in CER room.

.1 Phased demolition of existing HVAC, ducts, pipes, insulations, plumbing pipes and other HVAC equipment and associated control and electrical components, including legal disposal of equipment and materials.

.2 Phased installation of new HVAC and humidification equipment, piping, ductwork, grilles and associated control and electrical components and DDC system.

.4 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 construction phasing plan. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service.

.2 All equipment and associated components are to be delivered to the site in a timely manner so that the work can proceed without delays.

.3 All of the above mentioned works to be performed in an environment which contains hazardous building materials. Provide for work including removal of hazardous materials in accordance with requirements of specification Section 02 81 01 Hazardous Materials.

.4 Provide as-built drawings and closeout submittals.

.5 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.

.6 Vehicular access through the Matsqui Institution 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 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.

**1.3 WORK RESTRICTIONS**

.1 Notify Departmental Representative of intended interruption of power, heating, cooling, ventilation, 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.

.3 Provide for access by pedestrian and vehicular traffic on and around site where work is in progress.

.4 Security Requirements: refer to Section 01 14 10 - Security Requirements.

.5 Hours of work:

.1 Perform work during normal working hours of the Institution 0730 to 1600, Monday through Friday except holidays.

.2 When it is necessary, arrange in advance with Departmental Representative to work outside of normal working hours.

**1.4 CONSTRUCTION WORK SCHEDULE**

.1 Commence work immediately upon official notification of acceptance of offer and complete the work within 21 weeks from the date of such notification.

.2 Submittal:

.1 Submit to Departmental Representative within 5 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 Identify construction plan

.5 Departmental Representative will review schedule and return one copy.

.6 Re-submit two (2) copies of finalized schedule to Departmental Representative within five (5) working days after return of reviewed preliminary copy.

.3 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.

.4 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 paper work is acceptable.

## 1.5 SUBMITTAL PROCEDURES

.1 Administrative:

.1 Submit to Departmental Representative submittal 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 submittal 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. Submittal 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 review of submittal.

.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.

.2 Shop Drawings:

.1 Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.

.3 Product Data:

.1 Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that the product concerned is clearly identified. Submit in sets, not as individual submissions.

.4 Samples:

.1 Submit samples in sizes and quantities specified.

.2 Where colour is criterion, submit full range of colours.

.3 Submit all samples as soon as possible after the contract is awarded, to facilitate production of complete colour scheme by the Departmental Representative.

.5 Mock-ups: Not applicable.

.6 Progress Photographs:

.1 Provide construction photographs in accordance with procedures and submission requirements specified in this clause.

.2 Progress Photographs:

.1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression.

.2 Number of viewpoints: four (4), locations of viewpoints directed by Departmental Representative.

.3 Frequency: monthly, submitted on disk with monthly progress statement, sent via e-mail or as directed by Departmental Representative.

.4 Identify photos by location, date and sequential numbering system.

.3 Final Photographs:

.1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression. Where photos are e-mailed compression can be increased.

.2 Number of viewpoints:

.1 Each side of building for a total of 4.

.2 Interior of rooms and finishes for a total of 8.

.3 Locations of viewpoints determined by Departmental Representative.

.3 Submit final photographs in digital format on CD, before final acceptance of building.

.4 Label disks and identify with name and project number of project. Indicate exposure dates and viewpoints of each photo and photo number.

.7 Submission Requirements:

.1 Schedule submissions at least ten days before dates reviewed submissions will be needed.

.2 Submit number of copies of product data, shop drawings which Contractor requires for distribution plus four (4) copies which will be retained by Departmental Representative.

.3 Accompany submissions with transmittal letter in duplicate.

.4 Submit bond copies (hard copy) as directed by Departmental Representative.

.8 Coordination of Submissions:

.1 Review shop drawings, product data and samples prior to submission.

.2 Coordinate with field construction criteria.

.3 Verify catalogue numbers and similar data.

.4 Coordinate each submittal with requirements of the work of all trades and contract documents.

.5 Responsibility for errors and omissions in submittal is not relieved by Departmental Representative's review of submittal.

.6 Responsibility for deviations in submittal from requirements of Contract documents is not relieved by Departmental Representative's review of submittal, unless Departmental Representative gives written acceptance of specified deviations.

.7 Notify Departmental Representative, in writing at time of submission, of deviations in submittal from requirements of Contract documents.

.8 Make any changes in submissions which Departmental Representative may require consistent with Contract Documents and re-submit as directed by Departmental Representative.

.9 After Departmental Representative's review, distribute copies.

.10 Shop Drawings Review:

.1 Review of shop drawings by Public Works and Government Services Canada (PWGSC) is for the sole purpose of ascertaining conformance with the general concept.

.2 The Departmental Representative’s review does not mean that PWGSC approves the detail design inherent in the shop drawings, responsibility remains with the contractor submitting same, and such review will not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and contract documents.

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

## 1.6 HEALTH AND SAFETY

.1 Specified in Section 01 35 33.

## 1.7 ENVIRONMENTAL PROCEDURES

.1 Fires and burning of rubbish on site not permitted.

.2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.

.3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.

.4 Provide temporary drainage and pumping as necessary to keep excavations and site free from water during excavation and grading activities.

.5 Control disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements. Construct settlement ponds and silt fences as required by the Provincial Environmental authority.

.6 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

.7 Under no circumstances dispose of rubbish or waste materials on adjoining property.

## 1.8 REGULATORY REQUIREMENTS

.1 References and Codes:

.1 Perform Work in accordance with National Building Code of Canada (NBCC2015) and where applicable British Columbia Building Code (BCBC2012) including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

## 1.9 QUALITY CONTROL

.1 Inspection:

.1 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.

.2 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.3 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

.2 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.

.3 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.

.4 Reports:

.1 Submit (4) four copies of inspection and test reports to Departmental Representative.

.5 Tests and Mix Designs:

.1 Furnish test results and mix designs as may be requested.

.6 Mock-ups:

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.

.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.

.6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

.7 Mill Tests:

.1 Submit mill test certificates as requested and as required of specification Sections.

.8 Equipment and Systems:

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

.2 Refer to specific Section for definitive requirements.

## 1.10 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 Dewatering:

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

.3 Water Supply:

.1 Arrange, pay for and maintain temporary water supply in accordance with local authority, governing regulations and ordinances.

.2 Permanent water supply system installed under this contract may be used for construction requirements provided that guarantees are not affected thereby. Replace damaged components.

.4 Temporary Power and Light:

.1 Arrange, pay for and maintain temporary electric power supply in accordance with local power authority governing regulations and ordinances.

.2 Electrical power and lighting installed under this contract may be used for construction purposes at no extra cost, provided that guarantees are not affected thereby and electrical components used for temporary power are replaced when damaged.

.3 Replace lighting bulbs/tubes and clean reflectors and lenses used for more than three months.

.5 Temporary Communication Facilities:

.1 Provide and pay for temporary telephone and fax hook up, line(s) necessary for own use.

.6 Fire Protection:

.1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

## 1.11 CONSTRUCTION FACILITIES

.1 Installation and Removal:

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

.2 Scaffolding:

.1 Design, construct and maintain scaffolding in rigid, secure and safe manner, in accordance with WorkSafeBC regulations and Section 01 35 33.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

.3 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.

.4 Site Storage/Loading:

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

.5 Construction Parking:

.1 Make good damage to 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.

.6 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.

.7 Equipment, Tools and Material Storage:

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

.8 Sanitary Facilities:

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.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.

## 1.12 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.

## 1.13 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 born 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.

.6 The use of asbestos containing materials is prohibited in this project. Contractor shall provide a letter to the Departmental Representative prior to Substantial Completion confirming that asbestos containing materials are not used in this project.

.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.

**1.14 EXAMINATION AND PREPARATION**

.1 Existing Services:

.1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

.2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

.2 Location of Equipment and Fixtures:

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

**1.15 EXECUTION REQUIREMENTS**

.1 Preparation:

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

.2 Execution:

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.8 Cut rigid materials using 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.

## 1.16 CLEANING

.1 Project Cleanliness:

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.3 Clear snow and ice from access to building.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use clearly marked separate bins for recycling. Refer to-Construction/Demolition Waste Management And Disposal.

.6 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

.2 Final Cleaning:

.1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and 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.

.5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.6 Clean lighting reflectors, lenses, and other lighting surfaces.

.7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.8 Wax, seal, vacuum clean, shampoo or prepare floor finishes, as recommended by manufacturer.

.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.11 Remove dirt and other disfiguration from exterior surfaces.

.12 Sweep and wash clean paved areas.

.13 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.

.14 Clean roofs, downspouts, and drainage systems.

.15 Remove snow and ice from access to building.

## 1.17 CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL

.1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials and waste.

.1 Separate non-salvageable materials from salvaged items.

.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

.3 Transport and deliver non-salvageable items to licensed disposal facility.

.2 Provide containers to deposit reusable and/or recyclable materials. Locate containers in locations, to facilitate deposit of materials without hindering daily operations. Provide containers to deposit reusable and/or recyclable materials.

.3 Collect, handle, store on-site and transport off-site, salvaged materials in separate condition. Transport to approved and authorized recycling facility and/or users of material for recycling.

.4 Locate waste and salvage bins on site as directed by Departmental Representative.

.5 Provide removal of hazardous materials in accordance with Section 01 35 33 – Health and Safety Requirements and Section 02 81 01 Hazardous Materials.

## 1.18 CLOSEOUT PROCEDURES

.1 Inspection and Declaration:

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

.2 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.3 Request Departmental Representative's Inspection.

.2 Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.3 Substantial Completion: submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Certificates required by Authority Having Jurisdictions for seismic restraints.

.5 Operation of systems have been demonstrated to Departments personnel.

.6 Work is complete and ready for Final Inspection.

.7 Asbestos containing materials are not used in this project.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

## 1.19 CLOSEOUT SUBMITTAL

.1 Record Drawings:

.1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on as-built drawings as changes occur. At completion supply:

.1 Four (4) sets of CD's in AutoCad file format (version: 2010) and PDF format with all as-built information on the diskettes.

.2 Four (4) sets of printed as-built drawings.

.3 Submit one copy of check plots to Departmental Representative prior to final printing of as-built drawings.

.4 Departmental Representative will supply copies of the original AutoCad files.

.5 Retain original logo and title block on the as-built drawings. Contractor may place on the upper right-hand title block area a small company logo, the text "AS-BUILT" and the date.

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

.2 Operation and Maintenance Manuals (O&M Manuals):

.1 On completion of project submit to Departmental Representative four (4) CD R/ disk copies and four (4) paper copies (in loose leaf type binder) of Operation and Maintenance Manual, made up as follows:

.1 Provide maintenance manual on CDs using pdf, or other approved format for descriptive writing, page size images and page size drawings. Organize manuals into industry standard maintenance manual tabs with links in index to each descriptive section describing the component or maintenance procedure etc.

.2 Organize files into CSI Masterformat numbering system or other approved descriptive titles.

.3 Label disk "Operation and Maintenance Data", project name, date, names of Contractor, subcontractors, consultants and subconsultants.

.4 Include scanned guarantees, diagrams and drawings.

.5 Organize contents into applicable sections of work to parallel project specification break-down. Mark each section by labeled tabs (navigational buttons).

.6 Drawings, diagrams and manufacturer's literature must be legible.

.7 Refer to Mechanical and Electrical Divisions for specific details for Mechanical and Electrical data.

.2 At the time of review of substantial completion documents, an amount equal to one percent (1%) of total contract value must be allocated for operation and maintenance manuals and as-built drawings shown as a line item in the contractor progress billing. This amount shall be released after review and approval of O&M manuals by Departmental Representative.

.3 Maintenance Materials, Special Tools and Spare Parts:

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual sections.

.2 Deliver maintenance materials, special tools and spare parts to Departmental Representative and store in designated area as directed by Departmental Representative.

.3 Prepare lists of maintenance materials, special tools and spare parts for inclusion in O&M Manual specified in Clause 1.18.2.

.4 Maintenance materials:

.1 Deliver wrapped, identify on carton or package, colour, room number, system or area as applicable where item is used.

.5 Special tools:

.1 Assemble as specified;

.2 Include identifications and instructions on intended use of tools.

.6 Spare parts:

.1 Assemble parts as specified;

.2 Include part number, identification of equipment or system for which parts are applicable;

.3 Installation instructions;

.4 Name and address of nearest supplier.

.4 Warranties and Bonds:

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing in maintenance manual.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Interim Completion is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Retain warranties and bonds until time specified for submittal.

## 1.20 DEMONSTRATION AND TRAINING

.1 Demonstration and Training:

.1 Demonstrate operation and maintenance of equipment and systems to maintenance personnel following interim Completion and prior to date of final certificate of completion

.2 Departmental Representative will provide list of personnel to receive instructions and will coordinate their attendance at agreed-upon times.

## 1.21 GENERAL COMMISSIONING

.1 Commission installed systems in accordance with Section 01 91 00 - Commissioning prior to Demonstration and Training.

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 DEFINITIONS

.1 "Contraband" means:

.1 An intoxicant, including alcoholic beverages, drugs and narcotics

.2 a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization,

.3 An explosive or a bomb or a component thereof,

.4 Currency over any applicable prescribed limit, $25.00, and

.5 Any item not described in paragraphs (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 CPIC form and scanned copy of government issued ID for each employee to the Departmental Representative.

.2 Allow 10 working days for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at this institution except as approved otherwise.

.3 The Director may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Director may require that 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 tool boxes when not in use. Keys to remain in the possession of the employees of the contractor. Secure and lock scaffolding when not erected and when erected Secure in a manner agreed upon with the Institution designate.

.6 Report all missing or lost tools or equipment immediately to the Departmental Representative/Director.

.7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:

.1 At the beginning and conclusion of every work day or shift upon entering and exiting the Institution.

.2 At any time when contractor is on Institution property.

.8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day. Maintain up to date inventory of all used blades/cartridges.

.9 If propane or natural gas is used for 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 contractors vehicles.

.6 Private vehicles of construction employees will not be allowed within the security wall or fence of maximum security institutions 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

**PSPC Update on Asbestos Use**
**Effective April 1, 2016, all Public Works and Government Services Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit the use of asbestos-containing materials. Further information can be found at http://www.tpsgc-pwgsc.gc.ca/comm/vedette-features/2016-04-19-00-eng.html**

**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
- .2 Canada Occupational Health and Safety Regulations.

.2 National Building Code of Canada (NBC):

- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 The Canadian Electric Code (as amended)

.4 Canadian Standards Association (CSA) as amended:

- .1 CSA Z797-2009 Code of Practice for Access Scaffold
- .2 CSA S269.1-1975 (R2003) 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- Workplace Electrical Safety Standard

.5 National Fire Code of Canada 2010 (as amended)

- .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.

.6 American National Standards Institute (ANSI):

- .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.7 Province of British Columbia:

- .1 Workers Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation

**1.2 RELATED SECTIONS**

.1 Refer to the following current NMS sections as required:

.1 Section 01 01 50 – General Instructions

.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 General Instructions.

.2 Work effected by submittal shall not proceed until review is complete.

.3 Submit the following:

.1 Health and Safety Plan.

.2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.

.3 Copies of incident and accident reports.

.4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.

.5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 10 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 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, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

**1.7 HEALTH AND SAFETY COORDINATOR**

.1 The Health and Safety Coordinator (Registered Occupational Hygienist, Certified Industrial Specified Hygienist) must:

.1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.

.2 Be responsible for implementing, daily enforcing, and monitoring the site specific Health and Safety Plan.

.3 Be on site during execution of work.

**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 Working in the open exposed to unpredictable weather.

.6 High volumes of vehicular and pedestrian traffic

**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 related to project before start of work.

**1.13 FILING OF NOTICE**

.1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.

.2 Provide copies of all notices to the Departmental Representative.

**1.14 HEALTH AND SAFETY PLAN**

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

.1 Primary requirements:

.1 Contractor's safety policy.

.2 Identification of applicable compliance obligations.

.3 Definition of responsibilities for project safety/organization chart for project.

.4 General safety rules for project.

.5 Job-specific safe work, procedures.

.6 Inspection policy and procedures.

.7 Incident reporting and investigation policy and procedures.

.8 Occupational Health and Safety Committee/Representative procedures.

.9 Occupational Health and Safety meetings.

.10 Occupational Health and Safety communications and record keeping procedures.

.2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.

.3 List hazardous materials to be brought on site as required by work.

.4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

.5 Identify personal protective equipment (PPE) to be used by workers.

.6 Identify personnel and alternates responsible for site safety and health.

.7 Identify personnel training requirements and training plan, including site orientation for new workers.

.3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

## 1.15 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:

.1 Designated personnel from own company.

.2 Regulatory agencies applicable to work and as per legislated regulations.

.3 Local emergency resources.

.4 Departmental Representative.

.2 Include the following provisions in the emergency procedures:

.1 Notify workers 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.

## 1.16 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:

.1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 01 50 General Instructions.

.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 01 50 – General Instructions.

.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 brought 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 applicable Provincial Regulations.

.2 Removal and handling of asbestos will be performed as indicated in Division 2 specifications.

## 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 ELECTRICAL SAFETY REQUIREMENTS

.1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.

.1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.

.2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

## 1.20 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.

## 1.21 OVERLOADING

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

## 1.22 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1- 2014.

## 1.23 SCAFFOLDING

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

## 1.24 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Provincial regulations.

## 1.25 POWER-ACTUATED DEVICES

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

## 1.26 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.

**1.27 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.

.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.

**1.28 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.

**1.29 UNFORESEEN HAZARDS**

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

**1.30 POSTED DOCUMENTS**

.1 Post legible versions of the following documents on site:

.1 Health and Safety Plan.

.2 Sequence of work.

.3 Emergency procedures.

.4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.

.5 Notice of Project.

.6 Floor plans or site plans. Must be posted in a non-inmate access are 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) documents.

.9 Material Safety Data Sheets (MSDS).

.10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

**1.31 MEETINGS**

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

**1.32 CORRECTION OF NON-COMPLIANCE**

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.

.3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

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 PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:

AFD - Alternate Forms of Delivery, service provider.

BMM - Building Management Manual.

Cx - Commissioning.

EMCS - Energy Monitoring and Control Systems.

O&M - Operation and Maintenance.

PI - Product Information.

PV - Performance Verification.

TAB - Testing, Adjusting and Balancing.

.3 Provide third party commissioning agent(s) for mechanical and electrical systems. Provide costs of commissioning in tender price.

.4 Refer to sections of Mechanical, Electrical and Communications disciplines for specific requirements

### 1.2 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 BMM.

.3 Effectively train O&M staff.

.2 Contractor 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 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.

## 1.3 COMMISSIONING OVERVIEW

.1 Cx Agent:

.1 Hired and paid for by the Contractor.

.2 Responsibilities:

.1 Plan, coordinate, and carry out the Cx process.

.2 Develop Cx plan and Cx check forms (component, system and integrated system verification).

.3 Undertakes the component, system and integrated system performance verification testing and commissioning.

.4 Plans and carry out equipment demonstration and acceptance tests.

.5 Complete all Cx verification documentations.

.6 Chair Cx meetings.

.2 Cx to be a line item of Contractor's cost breakdown.

.3 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.4 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 is 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.

.5 Commissioning work to be completed prior Contractor’s request for Substantial Performance:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

## 1.4 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(s), including related systems as deemed required by Departmental Representative, 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 Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

## 1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Departmental Representative.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 .During Construction:

.1 Coordinate 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, systems is 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 Departmental Representative.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.

.10 Ensure "As-Built" system schematics are available.

.4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## 1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

## 1.7 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit immediately after award of Contract:

.1 Name of Contractor’s Cx Agent.

.3 Submit no later than 4 weeks after award of Contract:

.1 Draft Cx documentation.

.2 Preliminary Cx schedule.

.4 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 2 weeks prior to start of Cx.

.5 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 2 weeks prior to start of Cx.

.6 Provide additional documentation relating to Cx process required by Departmental Representative.

**1.8 COMMISSIONING DOCUMENTATION**

.1 Provide the following verification check sheets.

.1 Installation Check Lists and Product Information (PI) forms.

.2 Performance Verification (PV) forms.

.2 Departmental Representative to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Departmental Representative.

**1.9 COMMISSIONING SCHEDULE**

.1 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

**1.10 COMMISSIONING MEETINGS**

.1 Convene Cx meetings following project meetings.

.2 Purpose: to 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. Departmental Representative to call a separate Cx scope 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 Meeting will be chaired by Cx Agent who will record and distribute minutes.

**1.11 QUALITY ASSURANCE**

.1 Testing organization: current member in good standing of AABC certified to perform specified services.

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

**1.12 REFERENCES**

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

**1.13 SUBMITTALS**

.1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.

.1 Submit documentation to confirm organization compliance with quality assurance provision.

.2 Submit 3 preliminary specimen copies of each of report forms proposed for use.

.3 Ten (10) days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

.4 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

**1.14 PROCEDURES**

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Notify Departmental Representative 3 days prior to beginning of operations.

.3 Accurately record data for each step.

.4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

**1.15 CONTRACTOR’S RESPONSIBILITIES**

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

.5 Commission cost to be borne by Contractor.

## 1.16 PREPARATION

.1 Provide instruments required for testing, adjusting, and balancing operations.

.2 Make instruments available to Departmental Representative to facilitate spot checks during testing.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

.5 Verify lighting is turned on when lighting is included in cooling load.

.6 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

## 1.17 FINAL REPORTS

.1 Organization having managerial responsibility shall make reports.

.2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

## 1.18 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 deliverables have been submitted and accepted by Departmental Representative.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 22 05 00 – Common Work Results for Plumbing

### 1.2 DESCRIPTION

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative and maintenance personnel two weeks prior to date of interim completion.

.2 Departmental Representative will provide list of CSC personnel to Contractor and coordinate dates and times.

### 1.3 QUALITY CONTROL

.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Departmental Representative's personnel, and provide written report that demonstration and instructions have been completed.

### 1.4 SUBMITTALS

.1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.

.2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.3 Give time and date of each demonstration, with list of persons present.

### 1.5 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation.

.2 Testing, adjusting, and balancing has been performed and equipment and systems are fully operational.

.3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

### 1.6 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements. Prepare supplemental literature and handouts.

.2 Verify that designated personnel are present.

## 1.7 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location. All operational modes shall be demonstrated.

.2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

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

### 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 01 50 – General Instructions.

### 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 Kent Institution 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.

.1 All plumbing gaskets shall be considered asbestos containing materials (ACM).

.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 (1) 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 33 - Health and Safety.

## 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 01 50 – General Instructions.

.2 Section 01 35 33 – Health and Safety Requirements.

### 1.2 REFERENCES

.1 CSA International

.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.2 National Research Council Canada (NRC)

.1 National Building Code of Canada (2015) (NBC)

.2 National Fire Code of Canada (2015) (NFC)

.3 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.4 Federal Halocarbon Regulations

.1 For removal of refrigerant containing equipment and piping, ensure compliance with Federal Halocarbon Regulations.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 – General Instructions.

.2 Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management highlighting recycling and salvage requirements.

.2 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with authorities having jurisdiction.

### 1.4 SITE CONDITIONS

.1 Review "Designated Substance Report" and take precautions to protect environment.

.2 If 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 Proceed only after receipt of written instructions have been received from Departmental Representative.

.3 Notify Departmental Representative before disrupting building access or services.

## Part 2 Products

### 2.1 NOT USED

.1 Not used.

## Part 3 Execution

### 3.1 EXAMINATION

.1 Inspect building and site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

### 3.2 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work..

.2 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Demolition/Removal:

.1 Remove items as indicated.

.2 Removal of Pavements, Curbs and Gutters:

.3 Remove parts of existing building to permit new construction.

.4 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

.5 Dispose of all equipment and material legally.

**3.3 CLEANING**

.1 Progress Cleaning: clean in accordance with Section 01 01 50 – General Instructions.

.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 01 50 – General Instructions.

.3 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.4 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 01 50 – General Instructions.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Section 01 01 50 – General Instructions

.2 Section 01 35 33 - Health and Safety Requirements

### 1.2 REFERENCES

.1 Reports (further referred to collectively herein as the “Assessment Reports”), and bound to this specification in **Appendix A**, for reference.

.1 “Hazardous Building Materials Assessment Findings And Recommendations-Building M2A – Administrative Offices (831-07-RP)” prepared by Stantec, applicable to Room 136 in Building M2A at Matsqui Institution in Abbotsford, BC.

.2 Definitions:

.1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.4 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 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 Department of Justice Canada (Jus)

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act), (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 National Research Council Canada Institute for Research in Construction (NRC-IRC)

.1 National Fire Code of Canada 2015.

.5 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" (2017)

.4 "Safe Work Practices for Handling Lead" (2017)

.5 "Developing a Silica Exposure Control Plan" (2014)

.6 "A Hantavirus Exposure Control Program for Employers and Workers" (2006)

.6 British Columbia Hazardous Waste Regulation (BC Reg. 63/88)

.7 The British Columbia Waste Management Act - Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 387/99).

.8 The Federal PCB Regulations (SOR/2008-273).

.9 The Federal Halocarbon Regulations (2003).

.10 The Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations (COHSR)

.11 Canadian Construction Association

.1 Standard Construction Document CCA 82 "Mould Guidelines for the Canadian Construction Industry" (2004)

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 – General Instructions.

.1 Submit environmental exposure control plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

.2 Submit Provincial and/or local requirements for Notice of Project Form.

.3 Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.

.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.

.5 Construction Waste Management:

.1 Submit project Demolition Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating percentage of construction wastes were recycled or salvaged

.3 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

## 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 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials 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 When hazardous waste is generated on site:

.1 Co-ordinate transportation and disposal with Departmental Representative.

.2 Comply 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 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.

.5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.6 Only 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 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.

.12 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

.13 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

.5 Develop Demolition Waste Management Plan related to Work of this Section.

## 1.5 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 bound into this specification in the Appendix.

.2 Notify Department 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 pending instructions from the Department Representative.

# Part 2 Products

## 2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities hazardous material 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 MATERIALS ABATEMENT

.1 Scope of Abatement Activities for the project.

.1 Abatement shall be conducted to remove and dispose of hazardous building materials as identified in the Assessment Report(s) in accordance with applicable regulations, guidelines, standards and/or best practices for such work, where 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 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 that could otherwise have been clarified during the bidding period.

.4 The listing below is a summary of the hazardous building material categories and 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 Asbestos-containing Material that may require disturbance during the Work in the Project Area.

.2 Additionally, unidentified ACMs could potentially be concealed in various locations. Refer to the Assessment Reports for more detail. Should a material suspected to contain asbestos become uncovered during demolition activities, all work in the areas that may disturb the material must stop. Samples of the suspect material must be submitted for laboratory analysis to determine if asbestos is present.

.3 Abatement shall be conducted to remove and dispose of ACMs as identified in the Assessment Report in accordance with applicable regulations, guidelines, standards and/or best practices for such work.

.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:

.5 Fitting of equipment.

.6 Inspection and maintenance of equipment.

.7 Disinfecting of equipment.

.8 Limitations of equipment.

.4 Contractor is responsible for any and all supplemental assessment and/or pre-work site visits necessary to satisfy the requirements of the BC Reg. 296/97 as they may pertain to appropriate documentation of the following:

.1 Project plan (sequencing of work, duration of work, addressing unknowns, work methods, tools PPE, etc.)

.2 Site-specific hazard assessments/risk assessments, and development of site-specific safe work practices, as necessary

.3 Addressing potential for concealed or previously un-assessed potential ACMs

.5 Removal of identified ACMs is 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 Contractor is to conduct a risk assessment and document work procedures for actions/tasks that will or may disturb identified ACMs.

.2 Contractor is to submit the documented work procedures to the Departmental Representative for review, at least 5 days prior to initiation of work.

.3 Contractor must not proceed with work that will impact identified ACMs without approval from Departmental Representative.

.4 If air monitoring is required as part of the Contractor’s work procedures, Contractor shall retain an independent, competent 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 Department 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.

.4 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.

.5 Additional monitoring will be conducted, where possible, to verify procedural corrections were effective.

.6 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.

.7 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

.5 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 Owner, and at no impact to the schedule.

.6 Waste transportation to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.

.7 Waste disposal to be conducted in accordance with BC Reg. 63/88.

.8 Notify Departmental Representative of suspected ACM discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Department Representative.

.2 Lead and Lead-Containing Paints (LCPs)

.1 Refer to the Assessment Report for identities and locations of lead-containing materials (including LCPs) that may require disturbance during the Work in the Project Area.

.2 Actions that will disturb lead-containing materials (including paints and materials coated with LCPs) are to be conducted in accordance with the requirements of the current version of the WorkSafe BC publication “Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry”, keeping airborne exposure to lead dust to less than the 8-hour Occupational Exposure Limit (OEL) for lead of 0.05 milligram per cubic metre ($mg/m^3$).

.3 The actual methods to be used by the Contractor to complete the general Work of this Project may impact how and to what extent various lead-containing items and LCPs will require removal and disposal.

.1 The work tasks required and the ways in which lead-containing materials (including LCPs) will be impacted will determine the appropriate respirators, measures and procedures that should be followed to protect workers from lead exposure. This is to be determined by the Contractor through their own Risk Assessment.

.4 Although LCPs and items coated with LCPs will 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 LCPs from items or surfaces is not expected to be required during the Work.

.1 Refer to the provisions of the latest WorkSafe BC publication “Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry” 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 to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.

.6 Waste disposal to be conducted in accordance with BC Reg. 63/88.

.3 Polychlorinated Biphenyls (PCBs)

.1 Refer to the Assessment Report(s) for identities and locations of suspected PCB-containing equipment that may require disturbance during the Work

.2 When decommissioned, verify the PCB content of fluorescent lamp ballasts as per the Environment Canada publication Identification of Lamp Ballasts Containing PCBs, 1991.

.3 Should a material suspected to contain PCBs become uncovered during renovation activities (i.e., dielectric fluids, hydraulic fluids), all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if PCBs are present.

.4 PCB-containing items identified for removal and disposal should be handled, transported, stored and disposed of in accordance with the following:

.1 The transportation and disposal requirements of BC Reg. 63/88 .

.2 The transportation requirements of the Federal Transportation of Dangerous Goods Regulation.

.3 The Federal PCB Regulations (SOR/2008-273)

.4 Mould

.1 When renovation or demolition work proceeds, it is expected that mould and/or moisture impacted building materials, will be removed and disposed of during that process. Due to the actual or potential presence of mould on building materials, and if those impacted materials are to be removed by hand, workers should be notified of the potential presence of mould.

.2 Work associated with removal of mould-impacted building materials should be conducted by competent personnel, who are knowledgeable of potential hazards of mould exposure, using personal protective equipment and procedures in accordance with industry accepted practices for mould abatement (e.g. CCA 82).

Appropriate protective equipment would include the following, at a minimum:

.1 N95 respirator

.2 Impervious hand coverings (rubber gloves)

.3 Impervious foot coverings (rubber boots or disposable boot covers)

.3 Waste should be sealed in polyethylene bags and disposed of as general construction/demolition waste.

.5 Mercury

.1 Refer to the Assessment Reports for identities and locations of mercury-containing equipment that may require disturbance during the Work.

.2 When mercury-containing items are removed, ensure all mercury waste is handled, stored and disposed of in accordance with the requirements the following:

.1 The transportation and disposal requirements of BC Reg. 63/88.

.2 The transportation requirements of the Federal Transportation of Dangerous Goods Regulation.

.3 Precautions should be taken if workers may potentially be exposed to mercury or mercury vapours to ensure that workers exposure levels do not exceed the occupational exposure limit of 0.025 $mg/m^3$ as per the BC Reg. 296/97. This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed.

.6 Ozone-Depleting Substances (ODSs)

.1 Refer to the Assessment Reports for identities and locations of ODS-containing equipment that may require disturbance during the Work.

.2 ODSs must be handled, recycled, stored, and/or disposed of in accordance with the requirements of the following:

.1 British Columbia Waste Management Act – Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 387/99 as amended by BC Reg. 109/2002).

.2 Federal Transportation of Dangerous Goods Regulation.

.3 Federal Halocarbon Regulations.

.7 Radioactive Sources/Substances

.1 When radioactive equipment is to be removed, radioactive sources/substances must be recovered, handled, recycled, stored, and/or disposed of in accordance with the requirements of the following:

.1 The transportation requirements of the Federal Transportation of Dangerous Goods Regulation.

.2 Nuclear Safety and Control Act (1997, C.9).

.3 Nuclear Substances and Radiation Devices Regulations (SOR/2000-207).

.8 Silica

.1 When silica-containing materials are to be disturbed and/or removed (e.g., coring through concrete slabs, demolition of masonry or concrete units), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by BC Reg. 296/97 (Cristobalite and Quartz – each 0.025 $mg/m^3$). This would include, but not be limited to, the following:

.1 Developing a Silica 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.

.9 Biohazard Materials (Bird Faeces)

.1 Refer to the Assessment Report for identities and locations of Biohazard Materials (Bird Faeces) that may require disturbance during the Work.

.2 When renovation or demolition work proceeds, it is expected that biohazard materials will be encountered during that process. Due to the actual or potential presence of biohazard materials in the work area, workers should be notified of the potential presence of the biohazard material.

.3 Work associated with removal of biohazard materials building materials should be conducted by using personal protective equipment and procedures in accordance with industry accepted work practices for biohazard materials removal (e.g. Worksafe BC).

.10 Rodent-Borne Contaminants

.1 Refer to the Assessment Reports for identities and location of rodent-borne contaminants require disturbance during the Work.

.2 Handle, store, and dispose of rodent-borne contaminants as per WorkSafeBC Guideline entitled, A Hantavirus Exposure Control Program for Employers and Workers" (2006).

## 3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 50 – General Instructions. 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 01 50 – General Instructions.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

.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 federal and 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.

END OF SECTION

## Part 1 General

### 1.1 REFERENCES

.1 Editions of all Referenced Standards to be the ones designated by the applicable Building Code in force at the time of building permit application, as indicated on Structural Drawings. For Standards not referenced by the Building Code, use the latest editions.

.2 CSA Group (CSA):

- .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
- .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .4 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
- .5 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .6 CSA O141, Softwood Lumber.
- .7 CSA O151, Canadian Softwood Plywood.
- .8 CSA S269.1, Falsework and Formwork

.3 ASTM International Inc.:

- .1 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .2 ASTM C920 – Standard Specification for Elastomeric Joint Sealants
- .3 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .4 ASTM E1155M Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Number (Metric)
- .5 ASTM C1059, Standard Specifications for Latex Agents for Bonding Fresh to Hardened Concrete
- .6 ASTM A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- .7 ACI 117, Specification for Tolerances for Concrete Construction and Materials.
- .8 ACI 347, Guide to Formwork for Concrete.

.4 Reinforcing Steel Institute of Canada (RSIC):

- .1 Reinforcing Steel Manual of Standard Practice.

## 1.2 QUALITY ASSURANCE

.1 Qualifications

.1 Concrete supplier to have a valid “Certificate of Ready Mixed Concrete Production Facilities” issued by the relevant Ready Mixed Concrete Association.

## 1.3 QUALITY CONTROL

.1 Minimum two weeks prior to starting concrete work, provide valid certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

.2 For concrete with high volume of supplementary cementing materials (HVSCM concrete, as defined in CSA A23.1), perform trial mixes to ensure that the required properties are achieved.

.3 Minimum four weeks prior to starting concrete work, provide proposed quality control procedures on following items:

.1 Hot weather concrete.

.2 Cold weather concrete.

.3 Finishing.

.4 Protection.

## 1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meeting: convene pre-installation meeting one week prior to beginning concrete works. Ensure key personnel to attend.

.2 Batch Logs: keep record of each batch delivered to site.

.3 Concrete Delivery Slips: Keep all concrete delivery slips (“driver’s tickets”) on site until building is completed. Record on delivery slip where concrete was placed, including time and date.

## 1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Minimum 2 weeks prior to starting concrete work, submit all concrete mix designs, and indicate where each concrete mix is to be used.

.3 Minimum submission requirements for each concrete mix design shall include the following:

.1 Minimum specified compressive strength at 28 days (or at the time specified on drawings).

.2 Maximum aggregate size.

.3 Aggregate type (if not normal density).

.4 Concrete density range, wet and dry (if not normal density).

.5 CSA exposure class.

.6 Cement type (if not type GU).

.7 Percentage and type of supplemental cementing materials.

.8 Maximum water/cementitious materials ratio.

.9 Slump at point of discharge.

.10 Assumed method of placement of concrete.

.11 Alkali-aggregate resistance.

.12 Maximum time from batching to placing concrete (if retarding admixtures are used).

.4 Concrete pours: provide accurate records of all concrete pours marked on a set of Structural Drawings.

.5 Flatness and levelness: when requested, submit measurements of slab tolerances for each concrete pour.

.6 On completion of the works, provide written report to Departmental Representative certifying that the concrete in place meets performance requirements established in **Part 2 - Products**.

## Part 2 Products

### 2.1 DESIGN CRITERIA

.1 To CSA A23.1/A23.2, Alternative 1 – Performance, and as described under Mixes and on Structural Drawings.

### 2.2 PERFORMANCE CRITERIA

.1 Concrete supplier to meet the concrete performance criteria established by Departmental Representative and to provide verification of compliance.

### 2.3 MATERIALS

.1 Portland cement: to CSA A3001.

.2 Cementitious hydraulic slag: to CSA A3000.

.3 Fly ash: to CSA A3001, Type CI.

.4 Water: to CSA A23.1.

.5 Aggregates: to CSA A23.1/A23.2. Do not use recycled concrete as aggregate.

.6 Admixtures: not to contain chlorides.

.7 Corrosion-inhibiting admixture: calcium nitrite solution.

.8 Concrete mix (exterior slab on grade):

.1 Exposure class - F-2

.2 Minimum compressive strength - 30MPa

.3 Minimum size of course aggregate - 20mm

.9 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2. Minimum compressive strength: 40 MPa at 28 days.

.10 Non premixed dry pack grout: composition of non metallic aggregate and Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 days.

.11 Curing/sealing compound: to CSA A23.1/A23.2 and ASTM C309, Type 1, Class B, water based acrylic.

.12 Compressible filler: flexible polyethylene closed cell expansion joint filler to ASTM D 4819, type II.

.13 Reinforcing steel: carbon steel, deformed bars to CSA G30.18., unless indicated otherwise.

.14 Forms

.1 Formwork materials to CSA S269.1

.2 Form liner: high density overlay plywood to CSA O121 or other special materials to achieve the required concrete finish.

.3 Form stripping agent: colourless mineral oil, non-toxic, low VOC, free of kerosene, with viscosity between 15 to 24 $mm^2/s$ (70 and 110s Saybolt Universal) at 40°C, flashpoint minimum 150°C, open cup.

.4 Grooves, reglets and chamfers: White pine selected for straightness and accurately dressed to size.

.15 POST-INSTALLED ANCHORS AND DOWELS

.1 Where drilled concrete anchors (dca) are noted on drawings, provide expansion anchors rated for seismic loads. Effective embedment lengths as follows:

12 (1/2”) diameter – 83 (3-1/4”) embedment

16 (5/8”) diameter – 102 (4”) embedment

19 (3/4”) diameter – 121 (4-3/4”) embedment

Where adhesive concrete anchors (aca) are noted on drawings, provide adhesive anchoring system with A306 threaded rods. Effective embedment lengths as follows:

12 (1/2”) diameter – 114 (4-1/2”) embedment

16 (5/8”) diameter – 143 (5-5/8”) embedment

19 (3/4”) diameter – 171 (6-3/4”) embedment

.16 Where rebar dowel anchors (rda) are noted on drawings, provide adhesive rated for seismic loads. See drawings for embedment lengths.

.17 Anchors located outside the building envelope’s vapour barrier to be hot dip galvanized.

.18 Concrete to be minimum 28 days old at the time of anchor installation.

.19 Use drilling and installation tools and procedures per manufacturers' recommendations.

.20 Do not cut reinforcement to accommodate drilled anchors and dowels.

.21 A when obstructions prevent drilling holes in specified locations to the required depth, relocate at no extra cost to the contract. Obtain Departmental Representative approval of new locations before drilling holes. Fill all abandoned holes with min. 30mpa grout. Do not tighten anchors until grout in adjacent abandoned holes reaches 75% fc'.

**2.4 CONCRETE MIXES**

.1 Use ready-mix concrete. Proportion concrete in accordance with CSA A23.1, Alternative 1 - Performance Method for Specifying Concrete.

.2 Set performance characteristics of concrete in plastic state in coordination with all trades involved.

.3 Meet performance criteria of concrete in hardened state as shown on Structural Drawings and provide verification of compliance.

.4 Do not use admixtures containing chlorides.

.5 Supplementary cementing materials (SCM):

.1 Conform to CSA A23.1.

.2 Follow slag and fly ash manufacturers' directions for proportioning and mixing of concrete.

.3 Do not use concrete with more than 40% of SCM when ambient temperature is forecast to be below +10ºC at the time of concrete pour and during the seven days after the pour, except for footings, walls and columns.

.4 Reduce W/C ratio to 0.45 where using more than 40% of SCM in concrete for slabs and other horizontal finished surfaces, in order to reduce bleed water and to increase rate or strength gain.

**EXECUTION**

**3.1 PREPARATION**

.1 Provide advanced notice as indicated on drawings to allow Departmental Representative field review of reinforcing prior to placing of concrete/closing of wall forms.

.2 Obtain Departmental Representative written approval before placing concrete.

.3 Obtain written approval of each foundation bearing surface by the Geotechnical Engineer registered in the province of B.C before placing concrete.

.4 Remove water and disturbed soil from excavations before placing concrete.

.5 Before placing slab-on-grade, confirm that subgrade and backfill meet specifications and are free of frost and surface water.

## 3.2 PLACING REINFORCING

.1 Do not field weld, cut or field bend reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure. Use tools which will limit bend radii to the values given in CSA A23.1

.3 Replace bars which develop cracks or splits.

.4 Remove all loose scale, dirt, oil or other coatings which would reduce bond.

.5 Ensure cover to reinforcement is maintained during concrete pour.

.6 Turn ends of tie wire towards the interior of concrete.

.7 Support bars, chairs and spacers:

.1 Provide sufficient support bars, chairs, carriers and side form spacers as necessary to secure against displacement of reinforcement and maintain concrete cover before and during concrete placement. Support devices contacting surfaces exposed to the exterior to be non-corroding.

## 3.3 FORMWORK INSTALLATION

.1 Use 25 mm (1”) chamfer strips on external corners and 25 mm (1”) fillets at interior corners, unless specified otherwise. Note that chamfers and fillets are not necessarily shown on drawings, for drafting simplicity.

.2 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

## 3.4 PLACING CONCRETE

.1 Place concrete in accordance with CSA A23.1.

.2 Delivery and place concrete with minimum re-handling.

.3 If concrete is pumped or placed pneumatically, control discharge velocity to prevent separation or scattering of concrete mix ingredients.

.4 Place concrete in a continuous operation without cold joints. If cold joints develop inadvertently, notify Departmental Representative to obtain instructions for required remedial work.

.5 Do not overload forms.

.6 Cast slabs with a top surface that is level or sloping as required by the Drawings.

.7 Concrete exposed to view:

.1 Exposed surfaces to be dense, even, uniform in colour, texture and distribution of exposed aggregate.

.2 Defects such as honeycombing, voids, loss of fines, visible flow lines, cold joints or excessive bug holes may be cause for rejection at the discretion of the Departmental Representative.

.8 Maintain accurate records of all poured concrete including extent, date and location of each pour, concrete mix used, ambient air temperature, test samples taken and falsework removal date and mark on a set of Structural Drawings.

## 3.5 FINISHING CONCRETE

.1 Finish concrete to CSA A23.1/A23.2.

.2 Cooperate with any trade applying finishes to concrete surfaces and provide surfaces which will ensure adequate bond. Provide chases and reglets where required.

.3 Finishing Flatwork:

.1 Protect concrete during finishing process. Use evaporation reducer during severe drying conditions.

.2 Provide final finish in accordance with proposed use and as follows:

.1 Wood float finish with brooming for: exterior exposed slabs.

.3 Surface Tolerances (flatness and levelness):

.1 Unless otherwise noted, conform to finish tolerance Class A.

.2 Measure surface tolerances using the F-Number method in accordance with ASTM E1155M within 72h of each concrete pour.

.4 Finishing Formed Surfaces:

.1 Completely fill holes left by through-bolts with grout.

.2 Do not patch surfaces until instructed in writing by Departmental Representative.

.3 Concrete exposed to view:

.1 Provide smooth-form finish.

.2 Rub exposed sharp edges with carborundum to produce 3 mm (1/8") radius edges unless otherwise indicated.

## 3.6 CONCRETE CURING AND PROTECTION

.1 At a minimum cure and protect concrete in accordance with CSA A23.1

.2 For concrete containing supplementary cementing materials, curing and protection times may need to be extended beyond those outlined by CSA A23.1 to achieve the required structural properties.

.3 Cure slab surfaces immediately after finishing is completed. Unless otherwise noted or required, use wet curing.

.4 Cover slab surfaces with absorptive mat or fabric and keep continuously wet.

.5 Slabs on grade:

.1 Apply 24 hours of continuous sprinkling with water. Start immediately after finishing slab.

.2 Cover slab for at least the following 72 hours using plastic sheets with joints taped and free edges covered.

.3 Protect finished and cured slab from surface water (i.e. rain, snow).

.6 Concrete exposed to view:

.1 Protect during construction period from wear, damage, marking, discolouration, staining and becoming coated with concrete leakage.

.7 Do not load concrete until sufficient strength is developed.

## 3.7 EXISTING STRUCTURE

.1 Take precautions to protect the existing structure from damage.

.2 Remove portions of existing concrete structure as required after installation of new steel framing.

.3 Provide temporary shoring and bracing as required.

.4 Obtain approval from Departmental Representative before coring or cutting existing slabs, beams or walls.

.5 Remove toppings prior to locating reinforcement and conduit.

.6 Mark locations and sizes of cores and openings and locations of reinforcement and conduit using indelible markers as follows:

.1 Red for top bars

.2 Green for bottom bars

.3 Black for cores, openings and conduit.

.7 Relocate proposed openings and repeat process at no extra cost to the Contract if proposed locations are not acceptable to Departmental Representative.

.8 Save the complete length of all cores. Label each core with location taken. Make all cores available for review by Departmental Representative. Dispose of cores only with approval of Departmental Representative. See details on structural drawings for saw-cutting procedure.

.9 If new reinforcement is required at an opening, install reinforcement before cutting opening or shore up structure until new reinforcement is installed.

.10 Roughening existing surfaces:

.1 Where drawings call for a roughened surface, bush hammer entire surface to a full amplitude of at least 5 mm.

.11 Patching:

.1 Patch existing concrete where necessary to provide required smooth, flat surfaces for reinforcement and for other trades.

## 3.8 INSPECTION AND TESTING

.1 Prior to placing footings, compaction and bearing capacity of under each pad to be confirmed in written reports by a geotechnical engineer retained by the contractor. Submit each report immediately to Departmental Representative.

.2 Locate all existing underground services prior to excavation.

.3 Protect footings, slabs-on-grade and adjacent soil against freezing and frost action at all times during construction. Do not pour concrete against frozen earth.

.4 Do not place concrete in water or on frozen soil.

.5 Field review of reinforcing:

.1 Notify Departmental Representative 48 hours prior to field review reinforcing. Forms and chairs to be completed prior to field review, as well as the subbase to be inspected by geotechnical engineer.

.6 Compressive Strength Testing:

.1 One test is required for each 100 cubic meters of placed concrete, but not less than one test for each concrete mix placed each day. At least 3 tests are required for each class of concrete used.

.2 A group of three cylinders for each test will be provided, Location of concrete placement will be recorded for each cylinder set. One specimens will be tested at 7 and one at 28 days. The third specimen will be tested at 56 days if the required strength at 28 days is not achieved.

.3 One additional cylinder will be provided for each concrete mix during cold weather concreting. The specimens will be cured on site adjacent to and under the same conditions as the work they represent, and will be tested prior to form removal.

.4 If standard on site cured cylinders are used to determine concrete strength prior to removal of formwork, they will be kept adjacent to and under the same conditions as the work they represent.

.7 Slump testing:

.1 A minimum of one standard slump test will be conducted for every compressive strength test taken.

END OF SECTION

## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Section 03 30 00: Cast in Place Concrete.

### 1.2 REFERENCES

.1 Editions of all Referenced Standards to be the ones designated by the applicable Building Code in force at the time of building permit application, as indicated on Structural Drawings. For Standards not referenced by the Building Code, use the latest editions.

.2 CSA Group (CSA):

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA S16, Limit States Design of Steel Structures.

.3 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.4 CSA W59, Welded Steel Construction (Metal Arc Welding).

.3 ASTM International Inc.:

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot Dip Galvanized) coating on Iron and Steel Products.

.2 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.

.3 ASTM A992, Standard Specifications for Structural Steel Shapes.

.4 ASTM F1554, Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength.

.4 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):

.1 CISC Handbook of Steel Construction.

.2 CISC/CPMA Standard 1-73a, A Quick-drying One-coat Paint for Use on Structural Steel.

.3 CISC/CPMA Standard 2-75, Quick-drying Primer for Use on Structural Steel.

.4 CISC Code of Standard Practice, Appendix I, Architecturally Exposed Structural Steel (AESS).

.5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:

.1 SSPC-SP 1, Solvent Cleaning.

.2 NACE No. 3 / SSPC-SP 6, Commercial Blast Cleaning.

.3 NACE No.4 / SSPC-SP 7, Brush Off Blast Cleaning.

.4 NACE No.2 / SSPC-SP 10, Near White Blast Cleaning.

.5 SSPC Technology Guide No.14 – Guide for the Repair of Imperfections in Galvanized, Organic or Inorganic Zinc-Coated Steel Using Organic Zinc Rich Coating.

.6 SSPC Paint Specification No. 20 – Zinc Rich Coating, Type I – Inorganic and Type II - Organic.

**1.3 QUALITY ASSURANCE**

.1 Qualifications

.1 Structural steel fabricator and erector to be certified by the Canadian Welding Bureau under the requirements of CSA W47.1, Division 1 or 2 for fusion welding and/or CSA W55.3, Division 1 or 2 for resistance welding of structural steel components.

.2 Welders to be appropriately qualified, working under direction of a qualified welding supervisor.

**1.4 QUALITY CONTROL**

.1 Source Quality Control Submittals:

.1 Provide all submittals 4 weeks prior to starting fabrication of structural steel.

.2 Tolerances

.1 Conform to the fabrication and erection tolerances of CAN/CSA S16.

**1.5 ACTION AND INFORMATIONAL SUBMITTALS**

.1 Shop Drawings:

.1 Provide fabrication and erection documents

.2 If additional information is required from Departmental Representative, allow a minimum of five working days for Departmental Representative to review and respond to the request for information.

.2 Fabrication documents:

.1 Submit shop details showing designed assemblies, member sizes, components and connections. Show on drawings:

.1 Material specifications.
.2 Surface preparation.
.3 Shop painting / galvanizing.
.4 Section splices.
.5 Types of shop and field connections.
.6 Net weld lengths.

**Part 2 Products**

**2.1 MATERIALS**

.1 Structural steel:

.2 Materials (to CSA G40.21 unless noted otherwise):

.1 Wide flange sections, channels and angles: grade 350W

.2 Plates, bars: grade 300w

.3 Steel joists: CSA G40.21, ASTM A1085, or ASTM A500

.4 Bolts, nuts and washers: ASTM F3125, GRADE A325

.5 Anchor rods: grade 300W; or ASTM F1554 GRADE 36

.6 Shop paint: CISC/CPMA 1-73A

.7 Shop primer paint: CISC/CPMA 2-75

.8 Welding materials: CSA W48 AND CSA W59

.3 Load indicating washers: to ASTM F959.

.4 Maximum percentage of boron in all structural steel elements and fasteners not to exceed 0.0008%.

.5 Welding materials: to CSA W48 and CSA W59, certified by Canadian Welding Bureau. For members in seismic force resisting system, refer to additional brittleness requirements in CSA S16.

.6 Shop paint primer: to CISC/CPMA 2-75, solvent reducible alkyd, red oxide, compatible with specified topcoat.

.7 Coating of steel members; ASTM F2329 (hot dip galvanized where exposed to weather (all exterior steel)

.8 Coating of fasteners: to ASTM F2329 (hot dip galvanizing), ASTM B695 (mechanical galvanizing) or ASTM F1136 (Zn/Al coating). All fastening elements (bolts, nuts, washers) to be coated using the same process and to be obtained from a single supplier. Nuts to have visible dye lubricant.

## 2.2 FABRICATION

.1 Fabricate structural steel in accordance with CSA S16 and with reviewed shop drawings.

.2 Weld in accordance with CSA W59 and CSA W186.

.3 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left unpainted, place marking at locations not visible from exterior.

.4 Match marking: shop mark bearing assemblies and splices for fit and match.

.5 Where shop inspection is required, do not ship material to the site before it has been inspected.

.6 Fabricate in stages complex members for which steel inspection is impossible or difficult once completed, and arrange for the Inspection and Testing Agency to do intermediate shop inspections.

## 2.3 SHOP PAINTING

.1 Clean all members to SSPC-SP 1 – Solvent Cleaning. Remove loose mill scale, rust, oil, dirt and foreign matter using any suitable method.

.2 In addition for members receiving shop primer paint: Clean steel to SSPC-SP 7 Brush-Off Blast Cleaning.

## Part 3 Execution

### 3.1 GENERAL

.1 Structural steel work: in accordance with CSA S16.

.2 Welding: in accordance with CSA W59 and CSA W186.

### 3.2 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing works prior to start of fabrication. Report discrepancies, modify connection details if required and submit to Departmental Representative for review. Determine any potential interference with existing services and report problem areas to Departmental Representative for direction before commencing work.

.2 Take precautions to protect existing works from damage. Provide temporary shoring as required. Repair damage to adjacent materials caused by structural steel installation.

### 3.3 ERECTION

.1 Erect structural steel in accordance with CSA S16 and reviewed erection drawings.

### 3.4 FIELD PAINTING

.1 Touch up damaged surfaces with the same paint as the shop coat.

.2 Clean and prepare surfaces of bolts, which will receive a finished coat of paint in the same manner as the connected steelwork.

### 3.5 INSPECTION AND TESTING:

.1 Field inspection:

.1 Arrange for the Departmental Representative to start field inspection as soon as each section of the Work is completed, plumbed, bolts tightened and field welding finished.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes, but is not necessarily limited to:

- .1 Steel framing and supports for mechanical, electrical, and communications equipment.
- .2 Steel framing and supports for applications where framing and supports are not specified in other Sections.
- .3 Steel pipe support frames.
- .4 Chain Link Fence

.2 Products supplied, but not installed, under this Section:

- .1 Loose steel lintels.
- .2 Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- .3 Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

### 1.2 REFERENCE STANDARDS

.1 Metal Fabrications to Canadian Institute of Steel Construction (CISC) “Code of Standard Practice for Structural Steel for Buildings”.

.2 Design, fabrication and erection to CAN/CSA-S16-09”, Limit States Design of Steel Structures”.

.3 Cold formed steel Work to CAN/CSA-S136-M, “Cold Formed Structural Steel Members”.

.4 Galvanizing to CSA G164-M, “Hot Dip Galvanizing of Irregularly Shaped Articles”.

### 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

- .1 Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- .2 Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing all anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- .3 Coordinate installation of components required to penetrate fireproofing to be placed prior to installation of fireproofing.

### 1.4 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by a professional engineer registered in the Province of British Columbia.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories. Indicate locations of field welds.

### 1.5 QUALITY ASSURANCE

.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Fabricator Qualifications: company with adequate plant, equipment, and skilled tradespersons to perform work expeditiously, and has been responsible for satisfactory installations similar to that required in the Work, during a period of at least the immediate past 10 years. Fabricators shall have experience working with all metal types specified in this Section.

.4 Welding Qualifications Qualify procedures and personnel according to the following:

.1 Structural steel components: weld structural components to CSA W59, by fabricators certified to CSA W47.1 and W55.3 as applicable.

### 1.6 PROJECT CONDITIONS

.1 Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

### 1.7 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Protection: Provide protective covering to shop finished metal fabrications. Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

.2 Minimize construction waste sent to the landfill, separate and recycle materials as specified in Division 01.

## Part 2 Products

### 2.1 SUSTAINABLE REQUIREMENTS

.1 Primers: VOC quantities lower than limits stated in Green Seal’s Standards GC-03 and GS-11 and SCAQMD Rule #1113.

## 2.2 MATERIALS

.1 Metal Surfaces, General:

.1 Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

.2 Include materials, products, accessories, and supplementary parts necessary to complete assembly and installation of this Section.

.3 Incorporate only metals free from defects that are visible, or that impair strength or durability. Provide only new materials of best quality, free from rust, waves and buckles, and are clean, straight, and with sharply defined profiles.

.2 Steel sections and plates: to CAN/CSA-G40.20/G40.21, and as follows:

.1 Rolled sections: Grade 300W.

.2 Hollow structural sections (HSS): Grade 350W, Class C.

.3 Plate: to CAN/CSA-G40.20/G40.21, Grade 260 W.

.3 Steel pipe: to ASTM A53/A53M standard weight, Schedule 40, seamless, Type E or S, Grade A or B.

.1 Interior: paint finish.

.2 Exterior: galvanized finish, except where paint finish indicated.

.4 Checkerplate: minimum 10 mm thickness, raised pattern.

.1 Interior: paint finish

.2 Exterior: galvanized

.5 Welding materials: to CSA W59.

.6 Welding electrodes: comply with CSA and AWS Codes for type of fabricated metal.

.7 Bolts and anchor bolts: to ASTM A307.

.8 Pit frames: galvanized, size indicated, complete with minimum 5 by 38 mm fillet, 3 by 25 by 100 mm long anchors, minimum 600 mm o.c. For short frames, provide minimum two anchors per length.

.9 Stainless steel plate, strip and sheet: to A240/A240M, Type 304, No. 4 finish except where otherwise specified, thickness indicated.

.10 Chain Link Fence and Gates: for Storage areas

.1 Fabric: 3.76mm (9 ga) steel wire vinyl coated, 50mm mesh with top and bottom selvages knuckled. Height of fence as indicated on interior elevation drawings. Mesh fabric to be polymer vinyl coated to ASTM A392, minimum coating thickness of 0.38mm, colour Black. Knuckled Safety selvage top and bottom.

.2 Post and Rails:

.1 Top rail, brace rail: 42mm O.D. galvanized pipe, plain ends, lengths to suit, connected by slip on sleeves complete with expansion springs every 4 m. Pipe to be of sufficient strength to carry live and dead loads without visual deflection. Use minimum schedule 40 pipe.

.2 Line posts: 60mm O.D. galvanized steel pipe with post top, of sufficient strength to carry all loads without buckling, spaced a maximum of 3 m on centre. Use minimum schedule 40 pipe.

.3 End and corner posts: 76mm minimum O.D. galvanized steel pipe of sufficient strength to withstand fabric tension. Brace with pipe identical to top rail.

.4 Run posts from floor slab to underside of structure above. Anchor at top with bracket slotted to allow for structural deflection of 20mm. Base plate, galvanized, with oversize holes. Drill into slab and set anchor bolts with epoxy.

.3 Swing Gates: Frames of 41mm O.D. galvanized steel pipe welded at all joints (welds zinc painted after welding) complete with malleable iron hinges, latch suitable for padlock that can be attached and operated from either side of gate, hinges to permit gates to swing back against fence 180 degrees if required. Gate opening 950mm wide x 2100 height.

.4 Fittings: manufactured from suitable materials having sufficient strength to perform the necessary function.

.5 Tension Wire: 3.77mm (9ga) galvanized wire affixed to chain link fabric by hog rails. Wire to be stretched taut along the bottom of the fabric and attached to all terminal and line posts and to the bottom of the fabric.

.6 Tension Bands: As required, spaced not more than 380mm apart on terminal posts.

## 2.3 MISCELLANEOUS MATERIALS

.1 Grout:

.1 Epoxy grout: non-shrink, non-expanding.

.1 Acceptable products: Sika Canada Sikadur Injection Gel Fast-Set, Hilti HY-150, W.R. Meadows Rezi-Weld 3/2 Epoxy Grout/Patch.

.2 Cementitious grout: non-shrink, non-expanding.

.1 Acceptable products: Sika Canada Sika Grout 212, W.R. Meadows Sealtight CG-86 Construction Grout.

.2 Construction adhesive: CAN/CGSB 71-GP-26, and ASTM D 3498, waterproof, high solids content, polyurethane for bonding metal to metal, and metal to wood.

.1 Acceptable products: LePage PL Premium Construction Adhesive.

.3 Stainless steel repair compound: machineable repair compound with stainless steel filler to seal pin holes, voids and cracks in stainless steel fabrications.

.1 Acceptable products: Aremco Pyro-Putty, Devcon Stainless Steel Putty, Loctite Fixmaster Stainless Steel Putty.

## 2.4 FABRICATION

.1 Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

.2 Incorporate means for fastenings of other work secured to work of this Section.

.3 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

.4 Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

.5 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.6 Fabricate work to remain free of warping, buckling, opening of joints and seams, distortion and permanent distortion.

.7 Do welding work in accordance with CSA W59 and W59.2, unless specified otherwise.

.1 Weld corners and seams continuously to comply with the following:

.1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

.2 Obtain fusion without undercut or overlap.

.3 Remove welding flux immediately.

.4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

.2 Perform stainless steel welding in accordance with CSA W47.1 and AWS D1.6 as applicable.

.8 Use self-tapping shake-proof flat oval headed screws on items requiring assembly by screws or as indicated.

.9 Use screws for interior metal work. Use welded connections for exterior metal work.

.10 Exposed fastenings: same material, colour and finish as metal to which applied unless indicated otherwise.

.11 Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

.12 Seal exterior steel fabrications to provide corrosion protection in accordance with CAN/CSA-S16.1.

.13 Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

.1 Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 3 by 38 mm, with a minimum 150-mm embedment and 50-mm hook, not less than 200 mm from ends and corners of units and 600 mm o.c., unless otherwise indicated.

.14 Assembly:

.1 Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.

.2 Corners: mitred, unless otherwise indicated.

.3 Fasten work using concealed methods unless otherwise indicated.

.4 Weld connections where possible, bolt where welding is not possible, and cut off bolts flush with nuts. Countersink bolt heads, and incorporate method to prevent loosening of nuts. Ream holes drilled for fasteners.

.5 Allow for differential movement within assemblies and at junctions of assemblies with adjacent work.

.15 Finish Work:

.1 Incorporate holes and connections for work installed as part of work of other Sections.

.2 Cleanly and smoothly finish exposed edges of materials, including holes.

.3 Cap open ends of sections exposed to view.

.4 Machine or grind floor plates, gratings, covers, bearings to obtain level support.

## 2.5 MISCELLANEOUS FRAMING AND SUPPORTS

.1 General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

.2 Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

.1 Fabricate units from slotted channel framing where indicated.

.2 Fabricate pipe support frames, and supports for lighting, lifts, and other equipment from steel sections of sizes recommended by manufacturer of equipment, complete with bearing plates, anchors, and bracing.

.3 Furnish inserts for units installed after concrete is placed.

.3 Finishes:

.1 Galvanize miscellaneous exterior framing and supports where indicated.

.2 Prime miscellaneous framing and supports with primer specified in Division 09 Section where indicated.

.3 Pipe support frames: paint.

## 2.6 SHELF ANGLES

.1 Fabricate shelf angles from steel angles of sizes indicated and for attachment to structural steel framing. Provide horizontally slotted holes to receive 19-mm bolts, spaced not more than 150 mm from ends and 600 mm o.c., unless otherwise indicated.

.1 Provide mitred and welded units at corners.

.2 Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 50 mm larger than expansion or control joint.

.2 For cavity walls, provide steel angle brackets of sizes indicated from structural steel frame to support angles. Space brackets not more than 150 mm from ends of individual angle segments and 600 mm o.c.

.3 Galvanize shelf angles and brackets located in exterior walls.

## 2.7 LOOSE STEEL LINTELS

.1 Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

.2 Steel angles: sizes indicated for openings. Provide 150 mm minimum bearing at ends.

.3 Weld or bolt back-to-back angles to profiles as indicated.

.4 Prime loose steel lintels located in exterior walls.

## 2.8 MISCELLANEOUS BRACKETS, SUPPORT CLIPS AND FASTENINGS

.1 Provide steel brackets, supports, angles, seats, clips, and other fastenings indicated, or as required for installation in other Sections for their work.

.2 Pre-drill for countersunk screw, bolts, and other fasteners.

.3 Form to profiles indicated, or as required.

.4 Coordinate fabrication of supports for millwork with Architectural Woodwork trade.

.5 Shop prime brackets and supports after fabrication.

## 2.9 STEEL WELD PLATES AND ANGLES

.1 Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.10 LOOSE BEARING AND LEVELING PLATES

.1 Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

.2 Shop prime paint after fabrication.

.3 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

.4 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.11 STEEL FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m$^2$ to CAN/CSA-G164.

.2 Shop primers: provide primers, comply with Division 09 painting Sections.

.3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

.4 Galvanizing repair paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

.5 Stainless Steel: Directional Satin Finish: No. 4.

## 2.12 SHOP FINISHING

.1 General:

.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

.2 Finish metal fabrications after assembly.

.3 Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

.2 Steel and iron finishes:

.1 Galvanizing: Hot-dip galvanize items installed on exterior side of air/vapour barrier, except as indicated. Comply with ASTM A 153M for steel and iron hardware and with ASTM A 123M for other steel and iron products.

.2 Shop Priming:

.1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.3 Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning.

.4 Clean surfaces to be field welded; do not paint.

.3 Stainless steel finishes:

.1 Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

.2 Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

.3 Run grain of directional finishes with long dimension of each piece.

.4 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## Part 3 Execution

### 3.1 INSTALLATION, GENERAL

.1 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

.2 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

.3 Field Welding: Comply with the following requirements:

.1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

.2 Obtain fusion without undercut or overlap.

.3 Remove welding flux immediately.

.4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

.4 Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

.5 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 ERECTION

.1 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.2 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.3 Exposed fastening devices to match finish and be compatible with material through which they pass.

.4 Provide components for building by other sections in accordance with shop drawings and schedule.

.5 Make field connections with bolts to CAN/CSA-S16.1, or weld.

.6 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.7 Grout metal posts, balustrades and similar components in metal sleeves cast into concrete with epoxy grout, unless indicated otherwise. Sleeve depth: minimum 75 mm.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

## 3.3 MISCELLANEOUS FRAMING AND SUPPORTS

.1 General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

.2 Mount overhead supports securely to concrete slabs. Use drilled-in concrete anchors, or other Consultant approved devices.

.3 Install items mounted on roof to meet requirements of Authority having Jurisdiction.

## 3.4 INSTALLING BEARING AND LEVELING PLATES

.1 Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

.2 Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

.1 Use non-shrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations unless otherwise indicated.

.2 Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.5 ADJUSTING AND CLEANING

.1 Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

.1 Apply by brush or spray to provide a minimum 0.05-mm dry film thickness

.2 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

.3 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section includes:

.1 Rough carpentry materials and accessories.

### 1.2 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

.3 Informational Submittals:

.1 Certificates:

.1 For products treated with preservative and fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:

.1 Information listed in AWPA M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.

.2 Moisture content after drying following treatment with water-borne preservative, and fire-retardant.

.3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

### 1.3 QUALITY ASSURANCE

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards. Factory mark panels to indicate compliance with applicable standard.

### 1.4 DELIVERY, STORAGE AND HANDLING

.1 Keep materials under cover and dry. Protect from weather and contact with damp surfaces. Provide for air circulation within and around stacks and under temporary coverings.

## Part 2 Products

### 2.1 SUSTAINABILITY REQUIREMENTS

.1 Adhesives, sealants, and sealant primers: VOC quantities lower than stated in SCAQMD Rule #1168.

.2 Provide engineered wood products with no added formaldehyde and low VOC emissions when tested in accordance with ASTM D6330.

**2.2 REGULATORY REQUIREMENTS**

.1 Each panel of fire-retardant treated material to bear ULC label indicating Flame Spread Classification, and smoke developed.

**2.3 LUMBER MATERIAL**

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:

.1 CAN/CSA-O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Dimension lumber:

.1 Light framing: S4S, species SPF, construction grade.

.2 Stud: S4S, species group Hem-Fir, stud grade.

.3 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:

.1 S2S is acceptable.

.2 Board sizes: "Standard" or better grade.

.3 Dimension sizes: "Standard" light framing or better grade.

**2.4 PANEL MATERIAL**

.1 Plywood, and wood based composite panels: to CSA O325.

.2 Douglas fir plywood (DFP): to CSA O121, standard construction, grade indicated.

.3 Canadian softwood plywood (CSP): to CSA O151, standard construction, grade indicated.

.4 Fire-retardant: for plywood, to CSA O80.27, to provide:

.1 Flame Spread Classification: 25 or less.

.2 Smoke developed of not more than: 25.

**2.5 ACCESSORIES**

.1 General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 38 mm into wood substrate.

.2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.3 General purpose adhesive: to CSA O112.9.

.4 Nails, spikes and staples: to ASTM F1667-11ae1.

.5 Bolts: 12.5 mm diameter unless otherwise indicated, complete with nuts and washers.

.6 Threaded Rod: 12.5mm diameter unless otherwise indicated, galvanized steel, complete with nylon spacers, nuts and washers.

.7 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

**2.6 FASTENER FINISHES**

.1 Galvanizing: to ASTM A153, Class D, and ASTM F2329, use galvanized fasteners for exterior work, interior highly humid areas, and pressure-preservative treated lumber.

**2.7 WOOD PRESERVATIVE**

.1 Pressure-preservative:

.1 Treat material to CAN/CSA-O80 using alkaline copper quaternary (ACQ) Type C.

.2 Materials: dried after treatment to moisture content of 19% or less.

.3 Identify each piece of treated material with tag or ink mark bearing Canadian Wood Preservers' Bureau quality mark.

.2 Pressure preservative treated materials as follows:

.1 Wood nailers, curbs, equipment support bases, blocking, stripping, and similar members related to roofing, flashing, vapour barriers, and waterproofing, except for wood that comes in direct contact with roofing membrane.

.2 Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

.3 Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

.4 Wood framing members that are less than 460 mm above the ground in crawlspaces or unexcavated areas.

.5 Wood floor plates that are installed over concrete slabs-on-grade.

.6 Other material as indicated.

.3 Surface-applied wood preservative:

.1 Copper napthenate or pentachlorophenal base water repellent preservative. Use clear for materials exposed in final assembly, coloured elsewhere.

**2.8 FIRE-RETARDANT-TREATED MATERIALS**

.1 General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

.2 Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when test is extended additional 20 minutes, and with flame front not extending more than 3.2 m beyond centreline of burners at any time during test.

.1 Use treatment that does not promote corrosion of metal fasteners.

.3 Kiln-dry lumber to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

## Part 3 Execution

### 3.1 PREPARATION

.1 Surface apply wood preservative to heartwood of pressure preservative treated wood resulting from cutting, trimming or boring, before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.

.3 Apply end sealer to cut ends of wood decking before installation.

### 3.2 INSTALLATION

.1 Comply with requirements of British Columbia Building Code 2012 supplemented as follows:

.1 Install furring and blocking as required to space-out work as required.

.2 Align and plumb faces of furring and blocking to tolerance of 1:600.

.3 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.4 Install wood cants, fascia backing, nailers, curbs, parapet caps and other wood supports as required and secure using galvanized fasteners.

.5 Secure with galvanized 9 mm corrosion resistant bolts where indicated, galvanized nails elsewhere. Locate fastening within 300 mm from ends, and uniformly spaced between. Space bolts at 1200 mm on centre and nails at 600 mm on centre except where indicated otherwise.

.2 Nailing strips, grounds and rough bucks:

.1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, electrical equipment mounting boards, and other work as required.

.2 Align and plumb faces of furring and blocking to tolerance of 1:600.

.3 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work. Except where indicated otherwise, use material at least 38 mm thick.

.3 Curbs, and fascia backing:

.1 Install wood fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.2 Install wood backing, dressed, tapered and recessed slightly below top surface of roof membrane for roof drains.

.3 Wood to be pressure treated. Wood that comes in contact with roofing membrane to be treated with a preservative which is compatible with roof membrane and membrane adhesive.

.4 On roof deck provide strips of roofing vapour retarder sheet under curbs, nailers and sleepers installed directly onto roof deck. Extend vapour retarder minimum 300 mm onto roof deck both sides of curbs or sleeper to allow for overlap and sealing to roofing vapour retarder. Apply as continuous strips, with 200 mm overlap at joints. Seal joints. Use same material used for roofing vapour retarder. Coordinate with roofing sub-trade.

## 3.3 ERECTION

.1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.2 Countersink bolts where necessary to provide clearance for other work.

## 3.4 SCHEDULE

.1 Electrical backboards: fire-retardant treated plywood, DFP or CSP, SEL TF grade.

.2 Subfloor at flooring in elevators: as recommended by elevator manufacturer for finished floor.

.3 Plywood related to roofing: Plywood, DFP or CSP, exterior SHG grade, thickness indicated. Use pressure-preservative treated plywood, compatible with roofing membrane.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Provide acoustic interior insulation batt as indicated.

### 1.2 SUBMITTALS

.1 Submit manufacturer's printed product literature, including installation instructions, MSDS sheets, specifications and data sheets in accordance with Division 01.

### 1.3 DELIVERY, HANDLING AND HANDLING

.1 Store insulation at a location where humidity and temperature duplicates those during installation and occupancy in order to stabilize the sheathing. Store in covered area, protected from the weather at all times

## Part 2 Products

### 2.1 MATERIALS GENERAL

.1 Insulation value thicknesses per inch based on values listed in the latest edition of NRC-Evaluation listings.

### 2.2 THERMAL BATT INSULATION – MINERAL WOOL (EXTERIOR WALL)

.1 Standard of Acceptance: Roxul Comfort Batt ™ Insulation:

.1 Stone wool insulation from basalt rock and slag to CAN/ULC S702, type 1

.2 Batt size: to fit stud spacing

.3 Batt thickness: as noted on drawings

.4 Non-combustible to ASTM E136, ULC 114, ASTM E84

.5 Thermal Resistance to ASHRAE 90.1

.6 Fungal Resistance Criteria, ASTM C1338

.7 Approved Alternate Manufacturers:

.1 Thermafibre Inc.

### 2.3 ACCESSORIES

.1 Acoustic Caulking: refer to Section 07 92 00 Joint Sealants.

## Part 3 Execution

### 3.1 EXAMINATION AND PREPARATION

.1 Examine substrates and do not proceed with installation until defects have been corrected. Examine the areas and conditions under which work of this section will be installed.

.2 Substrates are to be free of dust and debris, and ready to receive insulation.

.3 Verify that adjacent materials are dry and ready to receive insulation.

.4 Verify mechanical and electrical services within walls have been tested and inspected.

.5 Provide written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INTERFACE WITH OTHER SYSTEMS

.1 Fit insulation tight around electrical boxes, plumbing and heating pipes, ducts and other protrusions as indicated.

.2 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC S604 Type A chimneys and CAN/CGA B149.1 and CAN/CGA B149.2 Type B and L vents.

### 3.3 INSTALLATION

.1 General Notes:

.1 Install insulation to maintain continuity of acoustic performance to building elements and spaces.

.2 Offset joints in multiple layer applications.

.3 Do not enclose insulation until it has been inspected and approved by Consultant.

.4 Compliance: comply with manufacturer’s written data, including product technical bulletins, product catalogue installation instructions, and data sheets for all insulation products

.2 Application for Sound Rated Assemblies:

.1 Install insulation to full thickness of framing or as indicated on partition schedule.

.2 Install rigid insulation by pinning to u/s of gypsum board acoustic membrane and exposed ductwork as recommended by manufacturer. Ensure finished edge where exposed to view.

.3 Place sound attenuation insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

.4 Penetrations are to be acoustically caulked.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Air/vapour barrier materials and assemblies to provide continuous seal between components of building envelope, building penetrations, and tie-ins at junctions and openings.

.2 Provide air vapour barrier to the following components to ensure overlap to the field applied system:

.1 Roof / wall junctions.

.2 All junctions of dissimilar substrate materials.

.3 Wall sheathing.

### 1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meeting: Convene one week prior to commencing Work of this section.

.1 Review air/vapour barrier requirements including surface preparation, substrate condition and pretreatment, special details and flashings, installation procedures, and protection and repairs.

### 1.3 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.1 Product Data for each type of product specified.

.2 Manufacturer's installation instructions.

.3 Compatibility: Provide letter(s), provided and signed by manufacturer of membrane air/vapour barrier material(s), that products used on the project are compatible with adjacent materials, and materials with which the membrane will be in contact or sealed.

.4 Field quality control reports as noted herein.

### 1.4 MOCK-UP

.1 Construct typical air/vapour barrier and flashing around exterior windows and frames, junction with roof system; and interface with dissimilar substrates, refer to installation methods noted and manufacturer’s recommendations.

.2 Locate where directed by Consultant.

.3 Allow forty-eight (48) hours for inspection of mock-up by Consultant before proceeding with air/vapour barrier Work.

.4 When accepted, mock-up will demonstrate minimum standard for this work. Approved mock-up may remain as part of the Work.

## 1.5 QUALITY ASSURANCE

.1 Installer Qualifications: Company specializing in performing work of this section with minimum 5 years' experience with installation of air/vapour barrier systems. Completed installation must be approved by the material manufacturer.

## 1.6 QUALITY CONTROL

.1 Inspect air/vapour barrier after installation, prior to covering by insulation. Provide daily reports to Consultant during A/V Barrier installation period.

.2 Field Quality Control Reports - Content:

.1 Continuous structural support of air-barrier system has been provided.

.2 Site conditions for application temperature and dryness of substrates have been maintained.

.3 Maximum exposure time of materials to UV deterioration has not been exceeded.

.4 Surfaces have been primed.

.5 Termination mastic has been applied on cut edges.

.6 Air/vapour barrier has been firmly adhered to substrate.

.7 Compatible materials have been used.

.8 Transitions at changes in direction and structural support at gaps have been provided.

.9 Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.

.10 Penetrations have been sealed.

.11 Interfaces between different assemblies, air/vapour barriers and openings including curtain wall and window tie-in: report specifically on tie-in methodology and installation between materials.

.3 Provide photographs of air/vapour barrier work in process, condition of wall surfaces, submit with written reports. Photographs shall state vantage point, date taken, object element of visual inspection represented in photograph, any peculiarities or comments.

.4 Non-conforming Work: repair non-conforming work as follows:

.5 Repair work where inspections indicate non-conformance to specified requirements.

.6 Manufacturer's Services: Review complete installation for conformance to manufacturer's written instructions. Provide written report approving completed installation.

## 1.7 DELIVERY, STORAGE AND HANDLING

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

.2 Store away from weather exposure in enclosed area not subject to heat over 49°C.

## 1.8 AMBIENT CONDITIONS

.1 Provide forced air circulation during installation and curing periods for enclosed applications.

.2 Exercise caution for proper adhesion, curing when temperature below 4 degrees C.

.3 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.

.4 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

## 1.9 SEQUENCING AND PHASING

.1 Work is to be so scheduled as to provide an air tight seal at the end of each working day on the portion of the wall face being worked on.

.2 Coordinate with other related trades to provide a continuity of the air seal.

.3 Air vapour barrier is not designed for permanent exposure; confirm manufacturer's recommendations of limited exposure time before final cladding is installed.

# Part 2 Products

## 2.1 MATERIALS

.1 Components used to be single source from the same manufacturer.

.2 Membrane air/vapour barrier: SBS modified bitumen membrane or rubberized asphalt coated polyethylene or cross-laminated polyethylene bonded to modified asphalt, self-adhesive grade, 1.0 mm minimum thickness, 0.1 mm thickness polyethylene face.

.1 Acceptable materials:

.1 Bakor Inc. "Blueskin SA" flexible air/vapour barrier membrane

.2 W.R. Grace Construction Products "Perm-A-Barrier" flexible air/vapour barrier membrane

.3 IKO Industries Ltd. "Superseal Type III" air/vapour barrier membrane

.4 W.R. Meadows, "Air-Shield"

.5 Soprema "Sopraseal Stick 1100T" air/vapour barrier membrane

.6 Carlisle CCW-705 Air & Vapour Barrier

.3 Water and Air Barrier: Self-adhering reinforced modified polyolefin tri-laminate water resistive air barrier:

.1 Air Leakage: < 0.2 L/s m2 @ 75 Pa, to ASTM E2178.

.2 Water Resistance: Pass, to AATCC 127.

.3 Vapour Permeance: 29 perms minimum, to ASTM E96 Method B.

.4 Acceptable Products:

.1 BlueskinVP 160 by Henry,

.2 Delta-VentSA by Corsella-Dorken Products,

.3 WrapShield SA by VaproShield.

.4 Transition Barrier: Zinc coated steel sheet: Minimum 1.2 mm base metal thickness, sheet steel, zinc-coated, commercial steel Type B, ASTM A653/A653M, Coating Designation Z275. Surface: smooth, flat. Bend to shape required.

.5 Transition Barrier Tape: Double-sided butyl tape, minimum 50 mm wide.

.6 Substrate cleaner: Non-corrosive type recommended by sealant manufacturer compatible with adjacent materials.

.8 Termination Sealant: Single component, moisture cure, medium modulus sealing compound compatible with barrier materials, and substrates as recommended by membrane manufacturer.

.9 Backer rod: polyethylene, closed cell foam backer rod, compatible with membrane air/vapour barrier, recommended by manufacturer, diameter 50% larger than deflection joint dimensions indicated.

## Part 3 Execution

### 3.1 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept the Work of this section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous, and comply with air/vapour barrier manufacturer’s requirements.

.3 Report unsatisfactory conditions to Design Builder in writing.

.4 Proceed with Work once unsatisfactory conditions are corrected.

.5 Start of Work implies acceptance of conditions.

### 3.2 PREPARATION

.1 Remove loose or foreign matter which might impair adhesion of materials.

.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas and sharp protrusions.

.3 Ensure substrates are free of surface moisture prior to application of membrane and primer.

.4 Ensure metal closures are free of sharp edges and burrs.

.5 Prime substrate surfaces to receive membrane, adhesive, and sealants in accordance with manufacturer's instructions.

.6 Prior to application of covering material, i.e. insulation, etc., the manufacturer’s representative is to review the entire field and overlap areas to verify joints are completely sealed, also refer to Section 07 92 00 Joint Sealants.

## 3.3 PRIMER INSTALLATION

.1 Apply primer by brush or heavy nap, natural-material roller at rate recommended by manufacturer prior to membrane installation.

.2 Allow primer to dry completely before membrane application.

## 3.4 INSTALLATION – GENERAL

.1 Install membrane air/vapour barrier to dry surfaces at air and surface temperatures of minus 4 degrees C and above in accordance with manufacturer's recommendations, to locations indicated.

.2 Slit barriers to fit over, and around anchors, reinforcing wires, ties, and other penetrations.

.3 Seal around masonry anchors, reinforcing, ties, and other penetrations with applicable termination sealant.

.4 Overlap adjacent pieces and roll seams: 50 mm side lap, 75 mm end lap.

.5 At end of each working day seal top edge of sheet materials to substrate with applicable termination sealant.

.6 Inspect installation prior to enclosing. Repair punctures, damaged areas and inadequately lapped seams with a patch of membrane sized to extend 150 mm in all directions from perimeter of affected area.

## 3.5 INSTALLATION – MEMBRANE AIR/VAPOUR BARRIER

.1 Precut pieces of air/vapour barrier into easily-handled lengths.

.2 Remove silicone-coated release paper, where applicable, and position membrane carefully before placing length horizontally against surface.

.3 When properly positioned, place against surface by pressing firmly into place by means of hand roller ensuring full contact

.4 Install membrane into openings in walls, including but not limited to doors and windows. Terminate at points that will prevent visibility from interior. Apply membrane over junctions, at changes in wall construction, and other construction. Reinforce corners with additional piece of membrane cut and formed to seal corners. Caulk to ensure complete seal. Position lap seal over firm bearing.

.5 Deflection Joints: Install backer rod full length of deflection joint to provide convex profile surface for air/vapour barrier membrane installation. Loop air/vapour barrier over backer rod in positive shingle application. Roll seams to ensure full contact. Repair fishmouths.

.6 Do not allow rubberized asphalt surface of air/vapour barrier membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.

.7 Do not expose air/vapour barrier membrane to sunlight for more than thirty days prior to enclosure.

.8 When required by dirty or dusty site conditions, by surfaces having irregular or rough texture, or if difficultly is encountered in adhering air/vapour barrier to substrate, apply surface conditioner by spray, brush, or roller at rate recommended by manufacturer, before membrane installation. Allow surface conditioner to dry completely before applying primer or membrane.

## 3.6 INSTALLATION – WATER AND AIR BARRIER

.1 Install water and air barrier to exterior face of parapet sheathing, at curtain wall penetrations, and where indicated.

.2 Install fillet bead of termination sealant at inside corners.

.3 Position membrane carefully before placing length horizontally against surface.

.4 Remove protective film from self-adhesive surface, press firmly in place.

.5 Openings: Install membrane air/vapour barrier sill flashings. Adhere strips of water and air-barrier to jambs and head in positive shingled fashion. Seal to interior vapour retarder with applicable termination sealant.

## 3.7 INSTALLATION – TRANSITION BARRIER

.1 Install transition barrier transition at roof/wall junction. Minimum 150mm overlap at joints, sealed with double-sided butyl tape. Position lap over firm bearing. Provide screw fasteners at vertical and horizontal joints, and at 400mm on centre. No fasteners permitted within 150mm of corner/fold. Cover fasteners with air/vapour barrier membrane.

## 3.8 PROTECTION, REPAIR, AND CLEANING

.1 Protect work from damage and wear during remainder of construction period.

.2 Correct deficiencies in or remove work that does not comply with requirements; repair substrates, reapply air/vapour barrier, and repair flashings.

.3 Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Mechanically-fastened TPO membrane roofing system (Main Roof)

.2 Fully Adhered TPO membrane roofing system (Pool Roof)

.3 Vapour retarder.

.4 Roof insulation.

.5 Cover board (Adhered System)

.6 Accessories

### 1.2 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting before beginning roofing Work, with roofing contractor's representative and Consultant to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

### 1.3 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product Data: For each type of product indicated.

.3 Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

.1 Base flashings and membrane terminations.

.2 Tapered insulation, including slopes.

.3 Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.

.4 Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

.4 Engineering Calculations: For roofing system wind uplift values signed and sealed by an Engineer registered in the province of British Columbia.

.5 Samples for verification: Sheet roofing, of colour specified, including T-shaped side and end lap seam.

.6 Qualification Data: Letter of certification for authorized qualified installer from the manufacturer.

.7 Manufacturer's Certificate: signed by roofing manufacturer certifying that roofing system complies with specified performance requirements.

.8 Manufacturer's Installation Instructions: indicate special precautions required for fasteners and seaming the membrane.

.9 Closeout Submittals: Submit upon completion of Work:

.1 Warranty, copies of inspection reports, and Roof Maintenance Guide.

.2 Manufacturer's field report: in accordance with Division 01.

.1 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

## 1.4 QUALITY ASSURANCE

.1 Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

.2 Source Limitations: Obtain components for membrane roofing system including fasteners, adhesives, and adhesives from same manufacturer as membrane roofing or as approved by membrane roofing manufacturer.

.3 Pre-installation Roofing Conference: Conduct conference at Project Site.

.1 Meet with Owner, Consultant, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

.2 Review methods and procedures related to roofing installation, including manufacturer's written instructions.

.3 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

.4 Examine deck substrate conditions and finishes for compliance with all requirements, including flatness and fastening.

.5 Review structural loading limitations of roof deck during and after roofing.

.6 Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

.7 Review temporary protection requirements for roofing system during and after installation.

.8 Review roof observation and repair procedures after roofing installation.

## 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

.2 Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

.3 Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

**1.6 AMBIENT CONDITIONS**

.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

.2 Coordinate installing membrane roofing system components so insulation and board substrates are not exposed to precipitation or left exposed at the end of the workday.

**1.7 WARRANTY**

.1 Provide manufacturer’s written no dollar limit extended warranty signed and issued in name of Owner stating Work will be free from water infiltration resulting from manufacturing defects workmanship, and installation deficiencies, and defective products will be repaired, and replaced without cost to Owner as necessary to enable Work to perform as warranted.

.1 Warranty Period: 20 year full system warranty from date of Substantial Completion.

**Part 2 Products**

**2.1 SUSTAINABLE REQUIREMENTS**

.1 Adhesives, sealants, and sealant primers: VOC quantities lower than stated in SCAQMD Rule #1168.

.2 Primers, paints, sealers, coatings and wood finishes: VOC quantities lower than limits stated in Green Seal’s Standards GC-03 and GS-11 and SCAQMD Rule #1113. .

**2.2 PERFORMANCE CRITERIA**

.1 General:

.1 Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, and other defects in construction. Membrane roofing and base flashings shall remain watertight.

.2 Provide materials manufactured, supplied, or acceptable by membrane roofing system manufacturer, required by warranty

.2 Material Compatibility: Provide roofing materials compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

.3 Roofing System Design: Provide membrane roofing system identical to systems successfully tested by a qualified testing and inspecting agency to resist uplift pressures calculated according to BCBC, NBCC, and CSA A123.21, for the Project site.

## 2.3 TPO MEMBRANE ROOFING

.1 Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet, 1.5mm (60mil) thickness.

.2 Colour: Selected by Consultant.

.1 Acceptable products:

.1 Sure-Weld TPO by Carlisle SynTec Incorporated.

.2 Ultraply TPO by Firestone Building Products Company.

## 2.4 AUXILIARY MEMBRANE ROOFING MATERIALS

.1 General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

.2 Sheet Flashing: Manufacturer's standard reinforced and unreinforced thermoplastic polyolefin sheet flashing, 1.4 mm thick, minimum, suitable for adhesive-application, of same colour as sheet membrane.

.3 Bonding Adhesive: Manufacturer's standard.

.4 Edge Sealant: Manufacturer's standard.

.5 Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 25 by 3 mm thick; with anchors.

.6 Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 25 mm wide by 1.3 mm thick, pre-punched.

.7 Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

.8 Pipe and Plumbing Vent Flashing: Pre-moulded pipe boot flashings manufactured by membrane manufacturer, or conical one-piece spun aluminum flashing complete with minimum 100 mm wide thermoplastic coated flange.

.9 Roof pans: Form pans to receive roofing plastic from minimum 0.6071 mm thick thermoplastic coated galvanized steel sheet metal with minimum 200 mm upstand above roof drains and continuous 100 mm wide deck flanges with no open corners. Solder joints. Make pans minimum 50 mm wider than member passing through roof membrane.

## 2.5 SUBSTRATES AND FASTENERS

.1 Parapet Substrate Board: Fibreglass mat faced gypsum sheathing to ASTM C1177, water-resistant, thickness indicated.

.1 Acceptable products: DensDeck Prime by Georgia Pacific, CGC Securock Glass-Mat Sheathing.

.2 Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

.3 Plywood: to CSA O121 or CSA O151 in accordance with Section 06 10 00 – Rough Carpentry, panel materials, Sheathing Grade, thickness indicated, maximum practical lengths. Use only as indicated on the drawings.

**2.6 VAPOUR RETARDER**

.1 Self-adhering Rubberized Asphalt Sheet: comprised of SBS modified bitumen adhesive, factory-laminated to woven, high-density slip resistant polyethylene top surface, and release liner on bottom surface. Thickness: 0.76 mm. Moisture vapour permeance: 0.92 ng/Pa·s·$m^2$. Water absorption by weight: less than 0.1 percent.

.1 Acceptable products: manufactured or approved by membrane manufacturer.

**2.7 ROOF INSULATION AND INSULATION ACCESSORIES**

.1 General: Preformed roof insulation boards, standard sizes suitable for application, of thicknesses indicated.

.2 Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 2 or 3, glass-fibre mat facer on both major surfaces, flat and tapered where required.

.1 Acceptable products: AC Foam-11 by Atlas Roofing, ISO 95+ by Firestone Building Products, IKO Therm II and III by IKO Industries, ISO-1 and E'NRG'Y 2 by Johns Manville, Energy Smart and Carlisle Polyiso by Hunter Panels LLC (Carlisle).

.3 Cricket, tapered insulation: Polyisocyanurate Board Insulation by same manufacturer as field insulation, engineered to consistent slope, and in accordance with roof plan.

.4 Cover Board (Adhered System): Fibreglass mat gypsum board to ASTM C1177, water-resistant, thickness indicated

.1 Acceptable products: DensDeck Prime by Georgia Pacific, CGC Securock Glass-Mat Roof Board.

.5 Fasteners: Factory-coated steel fasteners and metal TPO welding plates with high solids top surface coating, complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation, cover boards, and membrane to substrate.

.6 Insulation Adhesive Adhered System): Two Component construction grade urethane designed for bonding roof insulation board to various substrates.

.1 Acceptable products: FAST adhesive by Calisle Syntec,, OlyBond 500 by OMG Roofing Products.

**Part 3 Execution**

**3.1 WORKMANSHIP**

.1 Do examination, preparation and roofing Work in accordance with ARCA Roofing Application Standards Manual.

## 3.2 EXAMINATION

.1 Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

.1 Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

.2 Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

.3 Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 – Steel Roof Decking.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 PREPARATION

.1 Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

.2 Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

.3 Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

## 3.4 DECK COVERING

.1 Install deck covering with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt boards together.

.1 Fasten deck covering to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

.2 Cut deck covering so edges are supported on centre of upper ribs of steel deck.

.2 Install continuous plywood deck covering under curbs and parapets, as indicated. Mechanically fasten to steel deck's upper rib surfaces, spaced minimum 300 mm o.c. at perimeter.

## 3.5 VAPOUR RETARDER INSTALLATION

.1 Prime substrate as required by manufacturer before applying vapour retarder.

.2 Apply self-adhesive vapour retarder to deck covering. Unroll vapour retarder and align membrane centered at low point of roof or drain.

.3 Install with minimum 75 mm. Lap ends minimum 150 mm.

.4 Seal vapour retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

## 3.6 INSULATION INSTALLATION

.1 Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

.2 Install tapered insulation under area of roofing to conform to slopes indicated.

.3 Install insulation under area of roofing to achieve required thickness. Install two or more layers with joints of each succeeding layer staggered from joints of previous layer minimum 150 mm in each direction.

.4 Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

.5 Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps larger than 6 mm with insulation.

.1 Cut and fit insulation within 6 mm of nailers, projections, and penetrations.

.6 Mechanically Fastened Insulation: Install insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to steel deck.

.7 Adhered Insulation: Secure insulation to the substrate with adhesive in accordance with the manufacturers specifications and requirements

.1 Adhere insulation to deck prior to adhering coverboard.

.8 Install cover board over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below minimum 150 mm in each direction.

## 3.7 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

.1 Mechanically fasten membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions to meet warranty requirements, and performance criteria including wind uplift resistance.

.2 Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

.3 Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

.4 Mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

.5 Apply membrane roofing with side laps shingled with slope of roof deck where possible.

.6 Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

.1 Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.

.2 Verify field strength of seams a minimum of twice daily and repair seam sample areas.

.3 Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

.4 Complete seams as work progresses.

.7 Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

.8 Seal cut edges with manufacturer's recommended sealant.

## 3.8 ADHERED MEMBRANE INSTALLATION

.1 Position membrane over the acceptable substrate. Fold membrane sheet back onto itself so half the underside of the membrane is exposed.

.2 Apply Bonding Adhesive in accordance with the manufacturer's published instructions, to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be hot air welded over the adjoining sheet. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the sheet and repeat the bonding procedures.

.3 Position adjoining sheets to allow a minimum overlap of 2 inches to provide a minimum 1-1/2" hot air weld.

.4 Continue to install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches and complete the bonding procedures as stated previously.

## 3.9 BASE FLASHING INSTALLATION

.1 Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

.2 Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

.3 Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

.4 Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

.5 Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

**3.10 EXAMINATION AND TESTING**

.1 Testing Agency: Engage qualified roof specialist examining and testing agency to perform tests and inspections.

.2 Roof specialist, examining and testing company shall review all aspects of roofing work, metal flashings, deck, and blocking.

.3 Roof specialist examiner has authority to initiate minor 'no cost' changes to details, to suit job site conditions.

.4 Roof examination shall be in accordance with inspection procedures outlined by ARCA, including following:

.1 Preliminary roof deck examination to ensure deck surfaces are in proper condition to receive roofing. Notify Contractor of deleterious conditions not corrected.

.2 Study of roofing specification, notification to roof subcontractor, and Design Builder of variances, discrepancies between good roofing practices, and that specified.

.3 Examination of roofing materials on site, notification to Design Builder of variances from specified materials.

.4 Examination of workmanship, installation of roofing materials, minimum one trip per day during roofing operations, made early each working day.

.5 Reports: Specialist examining, and testing company shall submit:

.1 Daily, written reports.

.2 Duplicate final report, typewritten, within one week final examination of any completed roof area, based on examination trips, results of examinations, in accordance with outlined procedures for roof examinations.

.6 Specialist examining, and testing company shall take photographs of roofing work in progress, condition of roof surfaces, submit with written reports. Photographs shall state vantage point, date taken, peculiarities and comments.

.7 Non-conforming Work: repair and retest non-conforming work as follows:

.1 Repair work where test results and inspections indicate non-conformance to specified requirements.

.2 Re-test system by same standard and test one additional location within the same system for every failed test result to determine compliance of replaced or additional work with specified requirements.

.3 Pay costs associated with non-conforming work.

## 3.11 PROTECTING AND CLEANING

.1 Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Design Builder and Owner.

.2 Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Provide base of wall and curb flashings

### 1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, including installation instructions, MSDS sheets, specifications and data sheets in accordance with Division 01.

.2 Samples:

.1 Submit 50 mm x 50 mm samples of each type of sheet metal material, colour and finish.

### 1.3 DELIVERY, STORAGE, AND HANDLING

.1 Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

.2 Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

### 1.4 QUALITY ASSURANCE

.1 Perform work to RCABC details and requirements

.2 Perform Work to CRCA Manual standard details and requirements.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

.4 Fabricator Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

## Part 2 Products

### 2.1 MATERIALS - PREFINISHED SHEET STEEL

.1 Prefinished steel with factory applied silicone modified polyester coating:

.1 Class F1S.

.2 Colour to complement colour of adjacent materials, i.e. metal siding painted concrete. Consultant to choose colour from full colour range.

.3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523.

.4 Coating thickness: not less than 25 micrometres.

.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D822 as follows:

.1 Outdoor exposure period 1000 hours.

.2 Humidity resistance exposure period 1000 hours.

.2 Thickness steel: Minimum 20 gauge for flashings

.3 Break formed prefinished steel to profiles indicated.

.1 Flashing to have 50 mm vertical leg.

.2 Parapet flashings should be secured with a hem strip at the front and color matched fasteners on the back. Lengths should be interlocked using “s lock”, mitered and sealed at the corners.

.3 Flashings should have a positive slope, 5 degrees or greater unless noted otherwise.

.4 Drip edges from same colour, material and thickness as adjacent metal cladding.

**2.2 ACCESSORIES**

.1 Isolation Coating: alkali resistant bituminous paint.

.2 Underlay for metal flashing: dry sheathing

.3 Sealants: as per Section 07 92 00 Joint Sealants.

.4 Cleats: of same material as flashing specified, and temper as sheet metal, minimum 50 mm wide. Thickness 20 gauge.

.5 Fasteners: of same material as sheet metal, to ASTM F1667, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

.6 Washers: of same material as sheet metal with soft neoprene washers.

.7 Plastic Cement: to ASTM D4586 Type I.

**Part 3 Execution**

**3.1 EXAMINATION**

.1 Verify existing conditions before starting work.

.2 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.

.3 Verify roofing termination and base flashings are in place, sealed, and secure.

## 3.2 PREPARATION OF SUBSTRATE

.1 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.

.2 Install starter, edge strips and cleats before starting installation.

.3 Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

## 3.3 INTERFACE WITH OTHER SYSTEMS

.1 Apply isolation coating to metal surfaces to be embedded in concrete.

.2 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.

## 3.4 INSTALLATION

.1 Fabrication and Installation of flashings is .to comply with the requirements of the RCABC Roofing Practices Manual.

.2 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

.1 Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

.2 Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

.3 Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

.4 Torch cutting of sheet metal flashing and trim is not permitted.

.5 Do not use graphite pencils to mark metal surfaces.

.3 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.

.4 All flashings are to be hemmed.

.5 Hem exposed edges on underside. Miter and seal corners with sealant.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.7 Form flashings, copings to profiles indicated on drawings.

.8 Use concealed fastenings except where approved before installation; fasteners should be installed at 300 mm o.c. maximum.

.9 Lock end joints and caulk with sealant.

.10 Caulk flashing at reglet cap with sealant.

.11 Cut triangle or diagonal joint to minimize cut joint

.12 Metal protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

.1 Coat back side of uncoated aluminum flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

.2 Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet. Secure in place and lap joints 100 mm.

.13 Insert metal flashing into reglets, under cap flashing to form weathertight junction.

.14 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 000 mm with no joints allowed within 1 000 mm of corners and intersections. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with sealant concealed within joints.

.15 Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 38 mm, except reduce pre-tinning where pre-tinned surface would show in completed Work.

.1 Do not solder metallic-coated steel and aluminum sheet.

.2 Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

.16 Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 75 mm centers.

.17 Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

.1 Interlock both exterior and interior bottom edge of coping with continuous cleat anchored to substrate at 300mm centers max.

## 3.5 ERECTION TOLERANCES

.1 Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 6 mm in 6 000 mm on slope and location lines as indicated and within 3 mm offset of adjoining faces and of alignment of matching profiles.

## 3.6 CLEANING AND PROTECTION

.1 Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

.2 Clean and neutralize flux materials. Clean off excess solder.

.3 Clean off excess sealants.

.4 Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

.5 Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Joint sealants at exterior and interior construction as indicated.

### 1.2 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product Data: Submit manufacturer's printed product literature, including installation instructions, MSDS sheets, specifications and data sheets in accordance with Division 01.

.3 Manufacturer's product information to describe:

.1 Caulking compound.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.4 VOC Content

.4 Informational Submittals:

.1 Manufacturer's instructions for installation of each product specified.

.2 Statement of Compatibility: Compatibility between sealants primers, and substrates is essential. Provide written declaration to Consultant stating that materials meet this requirement.

.3 Test Reports.

### 1.3 AMBIENT CONDITIONS

.1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.

.2 When joint substrates are wet.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

## Part 2 Products

### 2.1 SUSTAINABLE REQUIREMENTS

.1 Adhesives, sealants, and sealant primers: VOC quantities lower than stated in SCAQMD Rule #1168.

## 2.2 GENERAL

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 Where sealants are qualified with primers use only those primers.

.3 Stain-Test-Response Characteristics: Where sealants are specified to be non-staining, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

.4 Colours: match sealant colour to adjacent materials, as selected and approved by the Consultant.

.5 Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920 classifications for type, grade, class and uses.

.6 Compatibility: Provide joints sealants, primers and backings that are compatible with one another, and with joint substrates under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience.

.7 Sealants: not exude materials that travel into or onto adjacent materials, causing damage, or attracting soiling, which becomes apparent during service life of building.

## 2.3 SEALANTS

.1 Neutral cure, one part, low modulus silicone, movement range to ±50%, for exterior and interior use on concrete, precast concrete, masonry, metals, glass, control joints, expansion joints, between insulating glass units of curtain wall assembly, to ASTM C920, Type S, Grade NS, Class 50 (and inactive CAN/CGSB 19.13), colour selected by Consultant.

.1 Acceptable products:

.1 GE SCS2000 Silpruf,
.2 Dow Corning 790,
.3 Tremco Spectrum 1,
.4 Precora 890.

One component, polyurethane, for interior and exterior use in aluminum, glazing, curtain wall joints, heel beads, toe beads, air seals, to CAN/CGSB 19.13, colour selected by Consultant.

.1 Acceptable products:

.1 Tremco “Vulkem 116”,
.2 Sika Canada “Sikaflex 1-a”,
.3 Tremco “Dymonic”.

.3 Mildew-resistant caulking, to ASTM C920, Type S, Grade NS, Class 25, one part, high modulus silicone, movement range ±25%, not paintable, for interior use in wet areas around shower stalls and shower bases. Colour selected by Consultant.

.1 Acceptable products:

.1 Dow Corning 786,

.2 Tremco Tremsil 200,

.3 GE Sanitary SCS1700,

.4 Franklin International Titebond Kitchen and Bath Sealant.

.4 Mildew-resistant, paintable silicone, to ASTM C920, Type S, Grade NS, Class 25, one part, high modulus silicone, movement range ±25%, for interior use around vanity tops, kitchen countertops, other counter surfaces adjacent to painted surfaces.

.1 Acceptable Product:

.1 GE Groov Kitchen/Bath/Plumbing.

.5 Acrylics One Part: general purpose, one part, paintable translucent acrylic to CGSB 19-GP-5M, movement range ±10%, for interior use in dry areas around windows, door frames, interior caulking to gypsum board, masonry, and metals.

.1 Acceptable products:

.1 Tremco Mono 555,

.2 Franklin International Titebond Painters Plus Caulk,

.3 GE RCS20 Siliconized Acrylic Sealant.

.6 Acoustical Sealant, for use at perimeter joints in sound rated gypsum board partitions, and masonry partitions:

.1 For exposed and joints: non-sag, paintable, non-staining latex sealant complying with ASTM C834.

.1 Acceptable products: GE RCS20 Siliconized Acrylic Sealant.

.2 For concealed joints: to CAN/CGSB-19.21, non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

.1 Acceptable products: Tremco Acoustical Sealant.

.7 Joint Cleaner: Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.8 Primer: as recommended by manufacturer, meeting maximum VOC requirements.

.9 Back-up Materials:

.1 Backer rod: polyethylene, closed cell foam backer rod, compatible with sealant, recommended by manufacturer, diameter oversize 30 to 50% to suit joint.

.2 Bond breaker tape: polyethylene, pressure sensitive bond breaker tape which will not bond to sealant.

.3 Expanding Foam Sealant: Pre-compressed, open cell, chemically stabilized acrylic impregnation, adhesive backed, high density polyurethane foam, pre-compressed size indicated, width indicated, grey colour.

## Part 3 Execution

### 3.1 EXAMINATION

.1 Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.2 Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

### 3.2 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

### 3.3 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

.6 Test materials being sealed, caulked for staining, adhesion.

### 3.4 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

### 3.5 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

### 3.6 MIXING

.1 For multi-component sealants, mix materials in strict accordance with sealant manufacturer's instructions.

**3.7 APPLICATION**

.1 Sealant:

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.9 Apply non-paintable silicone sealants after wall surfaces have been painted.

.2 Curing:

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

**3.8 SCHEDULE**

.1 Perimeters of exterior openings where frames meet exterior facade of building.

.2 Coping joints and coping-to facade joints.

.3 Exterior joints in horizontal wearing surfaces.

.4 Seal around electrical and mechanical boxes in exterior walls.

.5 Sealant specified as related work noted in other sections in the specification and as indicated on the drawings

**CLEANING**

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 This Section includes all labour, materials, equipment, services, and supervision required to complete all outdoor and industrial acoustical sound absorption panels as indicated and to the full extent of the Drawings and Specifications.

### 1.2 RELATED SECTIONS

.1 05 50 00 Metal Fabrications

### 1.3 REFERENCE STANDARDS

.1 Vancouver Building By-Law (VBBL) 2007

.2 ASTM C423 Standard Test Method for Sound Absorption Coefficients

.3 ASTM D3273 Antifungal Test - Coating

.4 ASTM E413 Classification for Rating Sound Insulation

.5 ASTM E90-02 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.6 ASTM E90-75 Sound Proofing and Acoustical Absorption Products

### 1.4 SUBMITTALS

.1 Submit in accordance with Division 1.

.2 Submit manufacturer’s technical product data for specified products

.3 Submit shop drawings showing panel layouts, required clearances, field connection details and method of support.

.4 Submit 300 x 300mm selection and verification samples for each type of acoustical sound panel required, showing full range of exposed texture, mounting hardware and trim to be expected in completed work.

.5 Provide maintenance data for incorporation into maintenance manual specified in Division 1

### 1.5 QUALITY ASSURANCE

.1 Installer: Is experienced to perform the work of this section and who has specialized in the installation of work similar to that required for this project and who is acceptable to the product manufacturer.

**1.6 WARRANTY**

.1 Manufacturers' Warranty: Furnish two year written warranty executed to the Owner, against defects in materials and workmanship, dated from the date of Substantial Completion.

.2 Installer's Guarantee: Furnish two year written guarantee against defects in installation, dated from the date of Substantial Completion.

**1.7 DELIVERY, HANDLING AND HANDLING**

.1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

**Part 2 Products**

**2.1 ACOUSTICAL SOUND ABSORPTION PANEL MANUFACTURERS**

.1 The following are acceptable manufacturers of acoustical panel systems:

.1 AcoustiGuard-Wilrep Ltd. Mississauga, ON www.acoustiguard.com

.2 Acoustiblok Inc, Tampa FL, www.acoustiblok.com

.3 Other pre-approved

.2 Whenever alternative products are offered, submit supporting technical literature, samples, drawings and performance data in accordance with Division 1.

**2.2 SOUND WALL SILENT PROTECTOR – ABSORPTIVE / REFLECTIVE SOUND BARRIER WALL**

.1 Industrial outdoor sound panel as manufactured by AcoustiGuard.

.2 Materials:

.1 Panel Construction: Silent Protector™ panels shall be of PVC Homopolymer, SIC: 3084 CAS NO.: PVC Resin (9002-86-2) Titanium Dioxide (13463-67-7); Calcium carbonate (1317-65-3) supplied by North American resin suppliers. Silent Protector™ panels shall be manufactured in a co-extruded manner, using recycled virgin resins for the substrate and pure virgin resins for the cap stock. The cap stock (exterior layer) shall have Rigid Poly Vinyl Chloride (PVC) Exterior resistance with the use of UV TI02 to protect the colors from fading due to the ultra violet rays from the sun. The panel design shall sealed by a Licensed Professional Engineer, experienced in the design of sound barrier walls.

.2 Acoustical Characteristics: Silent Protector™ panels shall be Absorptive on one side of the panel with a perforated routing pattern. Silent Protector ™ panels shall also be inserted with Acoustical Mineral Wool RockBoard 35 - 09 81 13. The Sound Transmission Class (STC) of the Silent Protector™ panels shall be equal or greater than 31 with a Noise Reduction Coefficient (NRC) of 1.0 as determined in accordance with ASTM E90-75.

.3 Aesthetics: Silent Protector™ panel face colors and lengths shall be specified in the Contract Documents. (Owner to specify colors of each panel, color pattern for Silent Protector™ Absorptive Sound Wall.) The visual appearance of the Sound Barrier Wall, in terms of color, shall be uniform when viewed at a distance of 10m from the face of the wall.

.4 Steel Posts: Steel posts shall be hot rolled wide flange structural sections in accordance with shapes, sizes, details, and method of connection as shown on the drawings. All structural steel work shall conform to CSA Standard S 16 and grade of steel shall be G40.21-M 350W. All welds shall conform to CSA Standard W59 and CSA standard W47.1. All steel components to be hot dipped galvanized after fabrication in accordance with CSA Standard G164-M. The post design shall be sealed by a Licensed Professional Engineer.

.5 Post Footings: Concrete in augured footings shall be minimum 20 MPa and in non-standard, engineered footings, it shall be 25 MPa, all in accordance with OPAA 1 350. Depth and diameter of footing shafts shall be designed in accordance with CAN/CSA S6-06, Clause 5-7.2.

## 2.3 ALL WEATHER SOUND PANELS (AWSP)

.1 Industrial outdoor sound panel as manufactured by Acoustiblok.

.2 Materials:

.1 The exterior facing sheets shall be corrosion resistant aluminum allow, mill finish.

.2 Front sheet: 1mm (0.040”) perforated with 3.9mm diameter holes staggered 2.4mm.

.3 Back sheet: 0.9mm solid sheet.

.4 Frame Construction: 3mm all welded, corrosion resistant aluminum, mill finish, eyelets: 10mm )18 each on 1220 x 2440mm (4’ x 8’)

.5 Infill: Acoustiblok absorption core.

.3 Panel size: generally 1220 x 2440mm (4’ x 8’) and custom width units to suit space dimension. 60mm nominal thickness.

.4 Acoustical Properties when tested in accordance with ASTM E90-02 and ASTM E13-87:

.1 Noise reduction coefficient (NRC) - 1.00 (maximum possible)

.2 Minimum sound attenuation 2 dBA @ 100 Hz & 16 dBA @ 0 Hz

.3 Sound transmission coefficient (Rw/STC) not less than 29 (ASTM E90-02).

.5 Fire performance when tested in accordance with UL Std 723:

.1 Flamespread: 0

.2 Smoke Developed: 0

## 2.4 ACCESSORIES

.1 Acoustic Caulking: refer to Section 07 92 00 Joint Sealants.

## Part 3 Execution

### 3.1 EXAMINATION AND PREPARATION

.1 Examine surfaces scheduled to receive attached acoustical units for unevenness, irregularities and dampness that would affect quality and execution of work.

.2 Do not proceed with installation of acoustic panel system until unacceptable conditions are corrected.

### 3.2 MANUFACTURER'S INSTRUCTION

.1 Comply with the instructions and recommendations of the acoustical panel system manufacturer.

.2 Install materials in accordance with governing regulations, fire resistance rating requirements and industry standards applicable to work.

### 3.3 INSTALLATION

.1 Screw heads to be flush with panel surface, long edges butted together

### 3.4 Cleaning

.1 Clean exposed surfaces of acoustical panels in accordance with manufacturer's written instructions.

.2 Touch up any minor finish damage

.3 Remove and replace work which cannot be successfully cleaned and / or repaired.

.4 Promptly as work proceeds and at completion, clean up and remove from the premises and the project site rubbish and surplus materials resulting from work of this section.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions.

.2 Section 21 13 13 – Wet Pipe Sprinklers Systems.

### 1.2 SUBMITTALS

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

.2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

.3 Shop drawings to show:

- .1 Materials.
- .2 Finishes.
- .3 Method of Anchorage
- .4 Supports
- .5 Accessories
- .6 Certification of compliance to applicable codes.

.4 Closeout Submittals:

- .1 Provide in accordance with Section 01 01 50 – General Instructions.
- .2 As-Built drawings:
  - .1 Provide in accordance with Section 01 01 50 – General Instructions
  - .2 Submit to Departmental Representative for approval and make corrections as directed.
  - .3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .3 Submit copies of as-built drawings for inclusion in final TAB report.

### 1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 01 50 – General Instructions.

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

### 1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

- .1 Construction/Demolition Waste Management and Disposal in accordance with Section 01 01 50 – General Instructions.

## Part 2 Products

### 2.1 HANGERS AND SUPPORTS

.1 All hangers and supports shall conform to the appropriate NFPA and local jurisdiction standards.

### 2.2 MISCELLANEOUS METALS RELATED TO FIRE PROTECTION SYSTEM

.1 All miscellaneous metal related to the fire protection systems including all metal back up plates and supports for all ceiling or wall supported equipment is part of this section of the work.

## Part 3 Execution

### 3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Division 9 - Painting.

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

.3 Restore to new condition, finishes which have been damaged.

### 3.2 FIELD QUALITY CONTROL

.1 Site Tests: conduct tests in accordance with Section 01 01 50 – General Instructions and Section 21 13 13_Wet Pipe Sprinkler System, and submit report to Departmental Representative.

.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 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.

### 3.3 PROTECTION

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

END OF SECTION

## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Section 01 01 50 – General Instructions.

.2 Section 01 91 00 – Commissioning.

### 1.2 REFERENCES

.1 National Building Code Canada 2015

.2 National Plumbing Code Canada 2015

.3 Authority Having Jurisdiction

.4 ULC and FM Standards for applicable products

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 General Instructions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for all plumbing equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves, where applicable.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

### 1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 01 50 General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for all plumbing equipment for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with Departmental Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems where applicable.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports where applicable.

.5 Approvals:

.1 Submit two hard copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative. PDF draft copy may be submitted for review if agreed upon by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 Departmental Representative will provide one set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built (as-constructed) drawings:

.1 Prior to start of Testing, Adjusting and Balancing, finalize production of as-built drawings.

.2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing using as-built drawings.

.5 Submit completed reproducible as-built drawings (hardcopy, CAD and PDF) with Operating and Maintenance Manuals.

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

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

.1 Submit in accordance with Section 01 01 50 General Instructions.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers.

.1 TORX with pin (to remove fasteners).

**1.6 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect products 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.

**Part 2 Products**

**2.1 SECURITY FASTENERS**

.1 Fasteners used in areas accessible by inmates shall be TORX with pin, stainless steel screws, which require a special tool to remove the fasteners. Use fasteners compatible with material through which they pass.

**Part 3 Execution**

**3.1 EXAMINATION**

.1 Verification of Conditions: verify that existing conditions are acceptable for connection to new materials to be installed within this contract.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 PAINTING REPAIRS AND RESTORATION FOR PLUMBING EQUIPMENT**

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

.2 Restore to new condition, finishes which have been damaged.

**3.3 SYSTEM CLEANING**

.1 Clean interior and exterior of all plumbing equipment.

**3.4 FIELD QUALITY CONTROL**

.1 Site Tests: conduct operational tests and submit report as described in Section 01 01 50 General Instructions.

**3.5 COMMISSIONING**

.1 Test and verify operation of each fixture, valve, and electrically controlled device in accordance with Section 01 91 00 Commissioning.

**3.6 DEMONSTRATION**

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing. Random equipment will be tested.

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

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

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

.5 Perform in accordance with Section 01 01 50 General Instructions.

**3.7 CLEANING**

.1 Clean in accordance with Section 01 01 50 General Instructions.

.1 Progress Cleaning: 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 01 50 General Instructions.

**3.8 WASTE MANAGEMENT**

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

## 3.9 PROTECTION

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

END OF SECTION

## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Section 01 01 50 – General Instructions.

.2 Section 22 05 00 – Common Work Results for Plumbing.

### 1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)

.1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.2 ASTM International Inc.

.1 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

.2 ASTM B88M-16, Standard Specification for Seamless Copper Water Tube (Metric).

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)

.1 ANSI/AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International)

.1 CSA B242-05 (R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

.5 National Building Code of Canada

.1 NBCC-2015

.6 National Plumbing Code

.1 NPC-2015

.7 National Sanitation Foundation (NSF) / American National Standards Institute (ANSI).

.1 NSF/ANSI 61-16, Drinking Water System Components.

### 1.3 QUALITY ASSURANCE

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

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

.1 Provide submittals in accordance with Section 01 01 50 General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

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

**1.5 DELIVERY, STORAGE, AND HANDLING**

.1 Packaging Waste Management: remove in accordance with Section 01 01 50 General Instructions.

.2 Place materials defined as hazardous or toxic in designated containers.

**Part 2 Products**

**2.1 PIPING**

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type K: to ASTM B88M.

.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

**2.2 FITTINGS**

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.6 NPS 1 and smaller: wrought copper to ANSI/ASME B16.22; with stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

**2.3 JOINTS**

.1 Rubber gaskets, latex-free, 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: tin copper alloy.

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

**2.4 PROTECTIVE CONDUIT**

.1 Not applicable.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 INSTALLATION**

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

.2 Assemble piping using fittings manufactured to ANSI standards.

.3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.4 Buried tubing:

.1 Not applicable.

**3.3 VALVES**

.1 Isolate equipment, fixtures and branches with isolation valves.

.2 Balance recirculation system using existing valves. Mark settings and record on as-built drawings on completion.

**3.4 PRESSURE TESTS**

.1 Not applicable.

**3.5 FLUSHING AND CLEANING**

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

**3.6 PRE-START-UP INSPECTIONS**

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system is fully functional.

**3.7 DISINFECTION**

.1 Flush out, disinfect and rinse system to approval of Departmental Representative.

**3.8 START-UP**

.1 Timing: start up after:

.1 Disinfection procedures have been completed.

.2 Certificate of static completion has been issued.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

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

.4 Rectify start-up deficiencies.

**3.9 PERFORMANCE VERIFICATION**

.1 Scheduling:

.1 Verify system performance after leakage tests and disinfection are completed.

.2 Procedures:

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

.2 Verify performance of temperature controls.

.3 Verify compliance with safety and health requirements.

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

.5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 Not applicable.

**3.10 CLEANING**

.1 Clean in accordance with Section 01 01 50 General Instructions.

.1 Progress Cleaning: Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

## 3.11 WASTE MANAGEMENT

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Section 01 01 50 – General Instructions.

.2 Section 22 05 00 – Common Work Results for Plumbing.

### 1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM B32-08 (2014), Standard Specification for Solder Metal.

.2 ASTM B306-13, Standard Specification for Copper Drainage Tube (DWV).

.2 Canadian Standards Association (CSA International).

.1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.2 CAN/CSA-B70-12 (R2016), Cast Iron Soil Pipe, Fittings and Means of Joining.

.3 CAN/CSA-B125.3-12, Plumbing Fittings.

.3 National Building Code of Canada

.1 NBCC-2015

.4 National Plumbing Code

.1 NPC-2015

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 01 50 General Instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove in accordance with Section 01 01 50 General Instructions.

## Part 2 Products

### 2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary and vent Type DWV to: ASTM B306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.3.

.2 Wrought copper: to CAN/CSA-B125.3.

.2 Solder: lead free, to ASTM B32.

### 2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.

.2 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Cold caulking compounds.

.2 Above ground sanitary and vent: to CAN/CSA-B70.

.1 Joints:

.1 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

## Part 3 Execution

### 3.1 APPLICATION

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

### 3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code and local authority having jurisdiction.

### 3.3 TESTING

.1 Not applicable.

## 3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Not applicable.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (sanitary, vent) c/w directional arrows.

## 3.5 CLEANING

.1 Clean in accordance with Section 01 01 50 General Instructions.

.1 Progress Cleaning: Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

## 3.6 WASTE MANAGEMENT

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

## Part 1 General

### 1.1 GENERAL REQUIREMENTS

.1 Read all Divisions of the building specification, Tendering Requirements, Contract Forms, and Conditions of Contract, and Division 1 which contain items affecting Mechanical Work.

.2 If similarity or discrepancies are found between contents of Divisions 21, 22, 23, 25 and Division 1 or other documents stated above, the one with most stringent content shall be applicable.

.3 The Mechanical Work shall consist of the supply and installation of complete and operable systems and shall include all necessary labour, plant, materials, and incidentals for the work involved.

.4 The drawings and specifications are intended to describe complete working systems including all necessary labour and materials. Where items required to complete working system are not specified or shown on drawings, contractor shall include costs at no additional expense to Owner.

.5 Immediately inform the Departmental Representative, in writing, of all discrepancies, errors, omissions, contradictions and ambiguities during tender stage. The necessary Addendum or bulletin will be issued to all Bidders. Include a complete cross-checking of Drawing and Specifications for sizes and quantities to correspond correctly. Data mentioned in the Specifications and not shown on Drawings, and vice-versa, must be interpreted as part of the Work. Bring obvious discrepancies or omissions to the attention of the Departmental Representative during the Tender Period. Where discrepancies still exist within the documents, contractors shall allow for the more demanding installation or more stringent requirement.

### 1.2 SUBMITTALS

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

.2 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.4 Closeout Submittals:

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

.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.3 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit four copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.2 Prepare and insert into each operation and maintenance manual a CD containing electronic copy of approved O&M manual including approved AS BUILT drawings.

.8 Site records:

.1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.

.2 Transfer information weekly to reproducible, revising reproduciblep to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings in CADD with Operating and Maintenance Manuals.

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

## 1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 01 50 – General Instructions.

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

## 1.4 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 01 50 – General Instructions as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One glass for each gauge glass.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 01 50 – General Instructions.

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

## 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

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

## Part 2 Product

### 2.1 Access Doors

.1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:

- .1 Valves;
- .2 Volume and splitter dampers;
- .3 Fire dampers;
- .4 Controls, coils and terminal units;
- .5 Expansion joints;
- .6 Filters;
- .7 Strainers

.2 Mark removable ceiling tiles used for access with colour coded dots.

.3 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

## Part 3 Execution

### 3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Division 9 - Painting.

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

.3 Restore to new condition, finishes which have been damaged.

### 3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers.

### 3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions.

.2 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01 01 50 – General Instructions.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in Section 01 01 50 – General Instructions.

## 3.4 DEMONSTRATION

.1 Contractor will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 HVAC Systems

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

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

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

.6 Contractor will record these demonstrations on video tape for future reference. Submit the recording media to Owner.

## 3.5 PROTECTION

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

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 23 07 15 - Thermal Insulation for Piping

.2 22 11 16 - Domestic Water Piping

.3 23 21 13.02 – Hydronic Systems Steel

.4 This section applies to all related work under Div. 22 and Div. 23.

### 1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181Ready-Mixed Organic Zinc-Rich Coating.

.2 National Fire Code of Canada (NFCC 2015)

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment 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 Section 01 01 50 – General Instructions and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return of pallets crates padding and packaging materials in accordance with Section 01 01 50 – General Instructions.

## Part 2 Products

### 2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181-99.

.1 Primers Paints Coating: in accordance with manufacturer's recommendations for surface conditions.

.2 Primer: maximum VOC limit to Standard GS-11.

.3 Paints: maximum VOC limit to Standard GS-11.

.2 Fire Stopping: in accordance with Section 01 01 50 – General Instructions.

## Part 3 Execution

### 3.1 APPLICATION

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

### 3.2 PIPE TYPE APPLICATIONS

.1 All above ground piping shall be SCH 40 black steel.

### 3.3 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

### 3.4 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

### 3.5 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain.

.1 Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### 3.6 AIR VENTS

.1 Install air vents to at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

## 3.7 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

## 3.8 PIPEWORK INSTALLATION

.1 Install pipework to applicable standard.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material. Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves. Use gate or ball valves at branch take-offs for isolating purposes except where specified.

.6 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

## 3.9 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for firestopping.

.2 Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

## 3.10 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

## 3.11 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

## 3.12 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 01 50 – General Instructions.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

## 3.13 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Hydrostatic test heating water piping, to 1400 kPa or 1.5 times the working pressure of final system pressure, whichever higher, which shall hold without pressure drop for a period of not less than 2 hours. Make correction for variations in ambient temperature between start and finish of this test.

.3 Test drains for tightness and grade as required by the local plumbing inspector.

.4 Hydrostatically test domestic water piping to a pressure of 1.5 times operating pressure or at least 120 psi (860 kPa) and maintain test pressure without loss for a minimum of 4 hours.

.5 Test natural gas piping in accordance with local requirements.

.6 Tests shall last at least 4 hours and if leaks develop, these shall be corrected and test repeated in an approved manner and to satisfaction of Inspection Authorities.

.7 Arrange for a potable water purity test. Submit a laboratory report at substantial completion.

.8 Test all backflow preventers and include report in Data Books.

.9 Submit written confirmation of all testing.

.10 Pipework: test as specified in relevant sections.

.11 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.12 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.13 Conduct tests in presence of Departmental Representative.

.14 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.15 Insulate or conceal work only after approval and certification of tests by Departmental Representative .

**3.14 CLEANING**

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

### 1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1- Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

### 1.3 SUBMITTALS

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

.2 Product Data:

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

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.

.2 Shop Drawings: submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.3 Quality Control: in accordance with Section 01 01 50 – General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals

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

**1.4 QUALITY ASSURANCE**

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance Division 1 requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

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

.2 Waste Management and Disposal:

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

**Part 2 Products**

**2.1 GENERAL**

.1 Motors: high efficiency, in accordance with local power company standards, local by-laws and to ASHRAE 90.1.

**2.2 MOTORS**

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W (1/2 HP) : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 60 Hz, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 60Hz, 575 V, unless otherwise indicated.

**2.3 TEMPORARY MOTORS**

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

**2.4 BELT DRIVES**

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

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

.4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 01 50 – General Instructions.

**2.5 DRIVE GUARDS**

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.

.3 38 mm diameter holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

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

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

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

## 3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

## 3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01 01 50 – General Instructions.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in Section 01 01 50 – General Instructions.

## 3.4 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 SUMMARY

.1 Related Sections

.1 Section 01 01 50 – General Instructions.

.2 Section Includes

.1 Pads, hangers and supports for mechanical piping and equipment.

.3 This section applies to all related work under Division 22 and Division 23.

### 1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-07 - Power Piping, ASME B31.3-06 - Process Piping

.2 ASTM International

.1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

**1.4 CLOSEOUT SUBMITTALS**

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

**1.5 DELIVERY, STORAGE AND HANDLING**

.1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Instructions with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 01 50 – General Instructions.

**Part 2 Products**

**2.1 SYSTEM DESCRIPTION**

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under 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.

## 2.2 GENERAL

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

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

## 2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 13 mm FM approved.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed and FM approved to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut FM approved.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate FM approved to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies

.2 Steel brackets

.3 Sway braces for seismic restraint systems

.6 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.7 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

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

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion epoxy coated.

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

## 2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed FM approved.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

## 2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/$m^3$ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

## 2.6 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 2 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.

**2.7 EQUIPMENT SUPPORTS**

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

**2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

**2.9 PLATFORMS AND CATWALKS**

.1 None are required for HVAC equipment

**2.10 HOUSE-KEEPING PADS**

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size per manufacturers' instructions; chamfer pad edges.

**2.11 OTHER EQUIPMENT SUPPORTS**

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

**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, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete where applicable 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 approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

## 3.3 HANGER SPACING

.1 Plumbing piping: to Provincial Code and authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

| Maximum Pipe Size : NPS | Maximum Spacing Steel | Maximum Spacing Copper |
|---|---|---|
| up to 1-1/4 | 2.4 m | 1.8 m |
| 1-1/2 | 3.0 m | 2.4 m |
| 2 | 3.0 m | 2.4 m |
| 2-1/2 | 3.7 m | 3.0 m |
| 3 | 3.7 m | 3.0 m |
| 3-1/2 | 3.7 m | 3.3 m |
| 4 | 3.7 m | 3.6 m |
| 5 | 4.3 m | |
| 6 | 5.0 m | |
| 8 | 5.0 m | |
| 10 | 5.0 m | |
| 12 | 5.0 m | |

.7 Pipework greater than NPS 12: to MSS SP69.

## 3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

## 3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

## 3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

## 3.7 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01 01 50 – General Instructions.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in Section 01 01 50 – General Instructions.

## 3.8 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation including chiller, pumps, all equipment, and piping system.

### 1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)

.1 NFPA 13- Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC)

### 1.3 SUBMITTALS

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

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

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.

.2 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.1 Provide separate shop drawings for each isolated system complete with performance and product data.

.2 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

### 1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 01 50 – General Instructions.

## 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

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

.2 Waste Management and Disposal:

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

## 1.6 WORK INCLUDED

.1 Provide vibration isolation on all motor driven equipment with motors of 0.37 kW (0.5 HP) and greater power output (as indicated on the motor nameplate) and on piping, as specified herein. For equipment less than 0.37 kW, provide neoprene grommets at the support points. Electrical grommets are not acceptable.

.2 Provide seismic restraints for all isolated and non-isolated equipment and piping systems.

.3 Ensure isolators and restraining devices which are factory supplied with equipment meet the requirements of this section. Provide signed and sealed Letter of Assurance as required by this section.

.4 Ensure equipment manufacturers provide attachment points capable of withstanding specified seismic forces.

## 1.7 DESIGN CRITERIA

.1 Ensure 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.

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

.3 Design isolators and seismic restraints to meet the structural requirements of the Building Code.

.4 Where integral isolation/snubbing devices do not meet the seismic requirements provide secondary all directional snubbing devices.

.5 Design attachments to both the equipment and the structure to meet the specified forces involved. Have the attachment details to the structure approved by a Professional Engineer registered in British Columbia.

.6 Provide seismic restraints for pipes 65 mm diameter and larger except where the pipe hanger rod length, from attachment to structure to attachment of support hardware (i.e. top of clevis hanger) is less than 305 mm.

.7 Provide seismic restraints for all isolated piping and equipment, regardless of size.

**1.8 QUALIFICATIONS**

.1 Have all isolation/seismic restraint products tested and certified by an independent testing laboratory, or certified by a registered professional engineer, to demonstrate that the products meet the requirements of this section. If particular tests are carried out to represent an isolator type, the tests shall be valid for the full load range of the isolator. Submit such tests or certification on request.

**1.9 DESIGN PROFESSIONAL AND LETTERS OF ASSURANCE**

.1 Have the complete and functional seismic restraint system designed and certified by a British Columbia registered professional engineer.

.2 Submit Letters of Assurance for the design Work of this Section, signed and sealed by the design professional engineer.

.3 Have the design professional engineer undertake such field reviews as he or she determines to be necessary to confirm that the construction generally conforms with the design intent.

.4 Submit letters of Assurance of Field Review and Compliance for the design Work of this Section, signed and sealed by the design professional engineer, upon completion of the Work of this Section.

.5 Ensure that Letters of Assurance conform to the standard requirements of the Authority Having Jurisdiction.

**1.10 SUBMITTALS**

.1 Obtain all relevant equipment information and provide calculations, shop and placement drawings for all vibration isolation elements and steel bases for review before materials are ordered. Provide attachment to both the equipment and the structure meeting the specified forces involved. Have attachment details to the structure approved by a BC registered Professional Engineer.

.2 Submit samples of materials required to complete the work of this section for inspection and review if requested.

.3 Have the vibration isolation vendor provide a full inspection report of isolation/restraint products provided and installed, listing all deficiencies.

**Part 2 Products**

**2.1 GENERAL**

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

**2.2 ELASTOMERIC PADS**

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

**2.3 ELASTOMERIC MOUNTS**

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

**2.4 SPRINGS**

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor 100% relative humidity installations.

.4 Colour code springs.

**2.5 SPRING MOUNT**

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Performance: as indicated.

**2.6 HANGERS**

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

.6 Performance: as indicated.

## 2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

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

## 2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

## 2.9 ISOLATORS

.1 Supply all of the vibration isolation equipment from one approved supplier with the exception of isolators which are factory installed and are standard equipment with the machinery. In the latter case have the manufacturer supply certified calculations of the internal restraints as well as certified calculations for anchorage to the structure.

.2 Provide isolators of the following types

.1 Pad Isolators

.1 Neoprene pad isolators, as defined by CAN/CSA-S6. Select pads for a 15% static deflection. Hold down equipment mounted on neoprene pad isolators using anchor bolts, nuts, washers, and hemi-grommets.

.2 Neoprene Floor Isolators

.1 Neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 5 mm 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 with oil in the mechanical room.

.3 Spring Floor Isolators

.1 Spring mounts, with a minimum 25 mm deflection, complete with levelling devices, and minimum 6 mm thick ribbed neoprene sound pads with 1.3 mm minimum deflection. Design isolator to meet specified seismic requirements and bolt down using neoprene grommets.

.4 Hanger Isolators

.1 Spring hangers within minimum 25 mm deflection, complete with 6 mm thick sound pads sized for 0.5 mm minimum deflection, or neoprene hangers. A neoprene element alone, without a hanger box, is acceptable provided no short-circuiting occurs and equipment rotates above 1170 rpm.

.3 Select isolators at the supplier's optimum recommended loading, and do not load beyond the limit specified in the manufacturer's literature.

.4 Design springs with stiffeners ratio of kx/ky = 1.0 to 1.5 with a working deflection between 0.3 and 0.6 of solid deflection.

.5 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.

## 2.10 FLEXIBLE PIPE CONNECTORS

.1 Install Neoprene of EPDM flexible connectors between vibrating equipment and piping over 65 mm, except those pumps handling domestic water.

## 2.11 SEISMIC ROD CLAMP

.1 Use seismic rod clamps where the length of the threaded support rod for equipment/pipe/ductwork is over 50 times the rod diameter.

.2 Use 25 mm x 25 mm x 6.4 mm angle for threaded rod size 9.5 to 15.9 mm diameter.

.3 Use 38 mm x 38 mm x 6.4 mm angle for threaded rod size 19 to 32 mm diameter.

.4 Provide rod clamps complete with locking bolt.

## 2.12 SEISMIC SOLID BRACE FOR NON-ISOLATED EQUIPMENT/PIPING/DUCTWORK

.1 Provide two solid braces at 90E to each other at attachment point, for non-isolated hung equipment, piping, and ductwork.

.2 Use braces complete with formed steel solid brace anchors with two bolts holds for the solid brace and swivel hinge on a support bracket on each end of the brace.

## 2.13 MECHANICAL EQUIPMENT ANCHORS

.1 Anchors shall be provided by vibration isolation/seismic restraint supplier. The responsibility for the seismic restraint of resiliently mounted equipment, from attachment to structure to point of attachment to equipment, is that of the vibration isolation/seismic restraint supplier.

## 2.14 EPOXY PUTTY

.1 Steel reinforced epoxy putty with an ultimate compressive strength of 82,700 kPa.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

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

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

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

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

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

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

.7 Chiller CH-1 is to be mounted on seismic spring isolators with 65 mm static deflection.

### 3.3 ISOLATORS

.1 Execute the work in accordance with the specifications, and where applicable, in accordance with the manufacturer's instructions and only use workmen 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, and similar items.

.3 Isolate all floor or pier mounted equipment on spring floor isolators, unless otherwise specified.

.4 Isolate pumps and axial fans rotating at more that 1170 RPM on neoprene floor isolators. Use the lowest RPM scheduled for two speed equipment in determining isolator deflection.

.5 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 drilled inserts.

.6 For equipment mounted on a slab on grade, chillers and in-line pumps, mount on neoprene floor isolators, unless otherwise specified.

.7 For all electrical connections to isolated equipment, provide a 90° bend of flexible conduit for 25 mm conduit and smaller or 90° Crouse-Hind EC couplings for larger conduit. Use connections long enough so that the conduit will remain intact if the equipment moves laterally 300 mm from the installed position, and flexible enough to transmit less vibration to the structure than is transmitted through the springs.

.8 Select Spring Hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units, and any other vibrating sources.

.9 Provide Spring Hangers on all piping, tanks, etc. connected to a vibrating source, if the piping is in excess of 40 mm dia. Provide the hangers for a distance of 6.5 m for a 50 mm pipe and 11.5 m for a 250 mm pipe. Isolate other pipe sizes for a proportionate distance. Isolate all piping in mechanical rooms. If neoprene hangers are proposed for non-critical spaces, change to spring hangers at no additional cost in the event that the isolation proves inadequate.

.10 Where piping connected to noise generating equipment is routed from the mechanical room through walls and plumbing chases, position piping to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise.

## 3.4 EQUIPMENT INSTALLATION

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

## 3.5 NON-ISOLATED HANGING SYSTEM

.1 Follow the Seismic Restraint manual Guidelines for Mechanical systems published by SMACNA in the selection of the appropriate diameter of threaded rod for the associated load at each attachment point. Use the next largest size of rod if any doubt exists.

.2 Wherever possible keep piping, ducting and equipment within 300 mm of the structure (i.e. top of pipe/duct or equipment to the attachment point at underside of structure). Intermediate points may exceed this 300 mm rule but a consecutive 300 mm attachment must occur with 9 m for ducting and 12 m for piping. No further seismic restraint is required if these parameters are met and all threaded rods at restraint points exceed 6.3 mm diameter.

.3 Piping/ducting may be attached to walls and require no further restraint as long as it is attached within 300 mm of that wall.

.4 Use pipe riser clamps wherever possible on piping without thermal expansion, instead of clevis hangers.

.5 Trapeze parallel runs of piping/ducting except those pipes where thermal expansion is expected. Attach pipes to trapeze with "U" bolts. Where pipes are of different diameter, set the bottom of all pipes on the same horizontal plane, to accommodate attachment to the trapeze.

.6 Anchor ducts to trapezes at flange locations.

.7 Anchor pipes without thermal expansion penetrating structural walls to the wall at the point of penetration.

.8 Anchor ducts penetrating walls to the wall at the point of penetration.

.9 Place piping closer to the structural ceiling than ductwork, except where maintenance prone valves or other devices are installed in the piping.

.10 Set the minimum distance from drill holes to the edge of the concrete or adjacent drill holes as recommended by the manufacturer of the drill inserts.

.11 Place seismic bracing or cables for ductwork within 600 mm, in both directions from every turn on jog, then:

.1 space the transverse bracing at 9 m intervals;

.2 space the longitudinal bracing at 18 m intervals.

.12 Place seismic bracing or cables for pipes within 600 mm, in both directions from every turn or jog, then:

.1 space the transverse bracing at 12 m intervals;

.2 space the longitudinal bracing at 24 m intervals.

.13 Include anchored wall penetrations when calculating the 9/18 and 12/24 bracing spacings to determine the number of transverse and axial restraints required.

.14 Install the required restraints equidistantly between corner and penetration anchor points.

## 3.6 ANCHORING RIGIDITY

.1 Maximum air gap between anchor bolt and restraint housing anchor hole shall not exceed 3 mm.

.2 If the air gap exceeded 3 mm, the clearance must be reduced by hemi-grommets (where the bolt is concentric with the hole) or epoxy putty.

.3 Follow manufacturer's instructions to hand knead the 0.5 fast epoxy putty and fill the entire gap between the bolt hole and the anchor bolt.

## 3.7 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 Twice during the installation, at 25% and 60%completion stages.

.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.

.2 Inspection and Certification:

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

.2 Provide Departmental Represenative with notice 24 h in advance of commencement of tests.

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

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

## 3.8 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 SUMMARY

.1 Section Includes:

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

.2 This section applies to all related work under Division 22 and Division 23.

### 1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-15, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

### 1.3 SUBMITTALS

.1 Product Data:

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

.2 Product data to include paint colour chips, other products specified in this section.

.2 Samples:

.1 Submit samples in accordance with Section 01 01 50 – General Instructions.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

### 1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

### 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

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

.2 Waste Management and Disposal:

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

.2 Dispose of unused paint coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## Part 2 Products

### 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### 2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

| 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.

**2.3 EXISTING IDENTIFICATION SYSTEMS**

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Departmental Representative.

**2.4 PIPING SYSTEMS GOVERNED BY CODES**

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

.2 Sprinklers: to NFPA 13.

.3 Standpipe and hose systems: to NFPA 14.

**2.5 IDENTIFICATION OF PIPING SYSTEMS**

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

.2 Pictograms:

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

.3 Legend:

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

.4 Arrows showing direction of flow:

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

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

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

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

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

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

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

.2 Other pipes: pressure sensitive plastic-coated cloth 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.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

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

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

.3 Background colour marking and legends for piping systems:

| **Contents** | **Background colour marking** | **Legend** |
|---|---|---|
| ** Add design temperature | | |
| ++ Add design temperature and pressure | | |
| City water | Green | CITY WATER |
| Treated water | Green | TREATED WATER |
| Condenser water loop supply | Green | COND. WTR. LOOP SUPPLY |
| Condenser water loop return | Green | COND. WTR. LOOP RETURN |
| Chilled water supply | Green | CH. WTR. SUPPLY |
| Chilled water return | Green | CH. WTR. RETURN |
| Hot water heating supply | Yellow | HEATING SUPPLY |
| Hot water heating return | Yellow | HEATING RETURN |
| Exhaust coil heating supply | Yellow | EXHAUST COIL SUPPLY |
| Exhaust coil heating return | Yellow | EXHAUST COIL RETURN |
| Fluid cooler supply | Green | FC SUPPLY |
| Fluid cooler return | Green | FC RETURN |
| Air handling unit supply | Yellow | AHU SUPPLY |
| Air handling unit return | Yellow | AHU RETURN |
| Domestic hot water supply | Green | DOM. HW SUPPLY |
| Dom. HWS recirculation | Green | DOM. HW CIRC |

| Contents | Background colour marking | Legend |
|---|---|---|
| ** Add design temperature | | |
| ++ Add design temperature and pressure | | |
| Domestic cold water supply | Green | DOM. CWS |
| Waste water | Green | WASTE WATER |
| Storm water | Green | STORM |
| Sanitary | Green | SAN |
| Plumbing vent | Green | SAN. VENT |
| Natural gas | to Codes | |
| Fire protection water | Red | FIRE PROT. WTR |
| Sprinklers | Red | SPRINKLERS |

**2.6 VALVES, CONTROLLERS**

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

**2.7 CONTROLS COMPONENTS IDENTIFICATION**

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

**2.8 LANGUAGE**

.1 Identification in English.

.2 Use one nameplate and label.

**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 specified Division 9 - Painting has been completed.

## 3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and CSA registration plates as required by respective agency.

## 3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

## 3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

## 3.6 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy reduced in size if required in each operating and maintenance manual.

.3 Number valves in each system consecutively.

**3.7 CLEANING**

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

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

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

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

### 1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Departmental Representative within 30 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

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

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1 2016.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2015.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

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

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

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

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

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

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

### 1.3 PURPOSE OF TAB

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

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

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

**1.4 EXCEPTIONS**

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

**1.5 CO-ORDINATION**

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

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

**1.6 PRE-TAB REVIEW**

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

.2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

**1.7 START-UP**

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

**1.8 OPERATION OF SYSTEMS DURING TAB**

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

**1.9 START OF TAB**

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 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 Liquid systems:

.1 Flushed, filled, vented.

.2 Isolating and balancing valves installed, open.

.3 Calibrated balancing valves installed, at factory settings.

**1.10 APPLICATION TOLERANCES**

.1 Do TAB to following tolerances of design values:

.1 Hydronic systems: plus or minus 5 %.

**1.11 ACCURACY TOLERANCES**

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

**1.12 INSTRUMENTS**

.1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

**1.13 SUBMITTALS**

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

**1.14 PRELIMINARY TAB REPORT**

.1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

**1.15 TAB REPORT**

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

**1.16 VERIFICATION**

.1 Reported results subject to verification by Departmental Representative.

.2 Provide 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 satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. 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.

**1.19 AIR / WATER SYSTEMS**

.1 Standard: TAB to most stringent of this section or TAB standards of AABC SMACNA and ASHRAE.

.2 Do TAB of systems, equipment, components, controls including but not limited to the following:

.1 HVAC Systems

.3 Qualifications: personnel performing TAB current member in good standing of AABC qualified to standards of AABC.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.7 Locations of systems measurements to include as appropriate.

**1.20 OTHER TAB REQUIREMENTS**

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air and water systems specified this section.

.2 Quality assurance: as for air and water systems specified this section.

.2 Measurement of noise and vibration from equipment specified in Division 23.

.3 Smoke management

.1 Test for proper operation of all fire dampers, installed as a component port of air system specified in Division 23.

.2 Test for proper operation of duct smoke and fire detectors installed in air handling unit systems.

**1.21 POST-OCCUPANCY TAB**

.1 Participate twice in system checks during warranty period 3 months after acceptance and within 1 month of termination of warranty period.

**Part 2 Products**

**2.1 NOT USED**

.1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

.1 Not used.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 01 01 50 General Instructions

.2 23 31 13.0 Metal Ducts – Low Pressure to 500PA (2”W.G.)

.3 23 33 00 Air Duct Accessories

.4 23 37 20 Louvres, Intakes and Vents

### 1.2 REFERENCES

.1 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" – means "not concealed" as previously defined.

.3 Insulation systems – insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

### 1.3 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2010 – Latest Edition, Standard 90.1-2010 (I-P Edition) -- Energy Standard for Buildings Except Low-Rise Residential Buildings

.2 ASTM International Inc.

.1 ASTM B209M-10 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

.2 ASTM C335/C335M-10E1 – Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-11 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

.4 ASTM C449-07 (2013) – Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement

.5 ASTM C553-11 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.6 ASTM C612-10 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.7 ASTM C795-08 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

.8 ASTM C921-10 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

.9 ASTM D412-06AE2 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

.10 ASTM D1424-09 – Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum Type (Elmendorf) Apparatus

.11 ASTM E84-12 – Latest Edition, Test Method for Surface Burning Characteristics of Building Materials

.12 ASTM E96M-12 – Standard Test Methods for Water Vapor Transmission of Materials

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52MA – Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-2011 – Latest Edition – Commercial Adhesives

.5 National Fire Protection Association

.1 NFPA-90A - Latest Edition, Installation of Air Condition and Ventilating Systems

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards 2013.

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S102-10 – Latest Edition, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC-S701-11 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

## Part 2 Products

### 2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

### 2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

.5 Flexible Insulation:

.1 Ducting and Fittings:

.1 Flexible insulation with factory applied vapour barrier to be composed of fibrous glass formed into a flexible blanket and be suitable for application on exterior of round and rectangular ducts. Flexible insulation shall be used on rectangle ducts in concealed locations only.

.2 Specification Compliance:

.1 CGSB 51-GP-11b (Type 1)

.2 Class 6 ASTM C411-05, to meet CUA-90A (NFPA 90A).

.2 Vapour Barrier:

.1 The vapour barrier shall be composed of aluminum foil min 24 gauge (0.7 mil) thick, reinforced with fibreglass yarn mesh and laminated to permanently treated fire resistant kraft paper.

.2 Specification Compliance:

.1 ASTM-C411 to meet NBC 1974 or CUA-90A.

.3 Applications: Thicknesses as indicated in insulation schedule.

.1 Insulate circular exhaust air ducts for a minimum distance of 3000mm from the roof terminal or exterior wall opening, or to motorized dampers or as noted on drawing.

.2 Unheated fresh air ducts.

.3 Supply air ductwork, as noted on drawings.

.4 Finishes:

.5 All concealed ductwork will be left with factory applied vapour barrier facing as specified above, with no further finish required.

.6 Cover all exposed ductwork with a thermocanvas jacket as specified under “Jackets”.

.7 The bottom of duct insulation shall be pinned per TIAC standards.

.8 Insulation shall not be installed until spaces are weather tight and no risk of water.

## 2.3 JACKETS

.1 Canvas:

.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:

.1 To ASTM B 209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Smooth, Stucco embossed or Corrugated.

.4 Jacket banding and mechanical seals: 12 or 19 mm wide, 0.5 mm thick stainless steel.

**2.4 ACCESSORIES**

.1 Vapour retarder lap adhesive:

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

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

.6 Tape: self-adhesive, aluminum, reinforced, 50 or 75 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Tie wire: 1.5 mm stainless steel.

.9 Banding: 12 or 19 mm wide, 0.5 mm thick stainless steel.

.10 Facing: 25 mm stainless or galvanized steel hexagonal wire mesh stitched on one face or both faces of insulation or one face of insulation with expanded metal lath on other face.

.11 Fasteners: 2 or 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 PRE-INSTALLATION REQUIREMENTS**

.1 Ensure surfaces are clean, dry, free from foreign material.

.2 No insulation shall be installed until the area to be insulated is weather tight and there is no risk of water.

## 3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

## 3.4 DUCTWORK INSULATION SCHEDULE

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

| | **TIAC Code** | **Vapour Retarder** | **Thickness (mm)** |
|---|---|---|---|
| Rectangular cold and dual temperature supply air ducts | C-1/C-2 | yes | 25 |
| Round cold and dual temperature supply air ducts | C-2 | yes | 25 |
| Rectangular warm air ducts | C-1/C-2 | no | 25 |
| Round warm air ducts | C-2 | no | 25 |
| Supply and return ducts exposed in space being served | C-1/ C-2 | yes | 25 |
| Outside air ducts to mixing plenum | C-1 | yes | 50 |
| Mixing plenums | C-1 | yes | 50 |
| Exhaust duct 3000mm back from wall or roof penetration | C-1/C-2 | yes | 50 |
| Rectangular ducts outside | C-1 | special | 50 |
| Round ducts outside | C-1 | special | 50 |
| Acoustically lined ducts | none | | 50 |

- Interior ductwork does not require exterior insulation if acoustic insulation is provided.
- Exterior outdoor ductwork requires exterior insulation even if acoustic interior insulation is provided.

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC 2013 code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

| | **TIAC Code** | |
|---|---|---|
| | **Rectangular** | **Round** |
| Indoor, concealed | none | none |
| Indoor, exposed | CRF/1 | CRD/1 |
| Outdoor, exposed to precipitation | CRF/3 | CRD/3 |
| Outdoor, elsewhere | CRF/4 | CRD/5 |

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

.2 This section apples to all related work under Division 23.

### 1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547, Mineral Fiber Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) b Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus) Canadian Environmental Assessment Act (CEAA), 2012, c. 37.

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

## 1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.

.3 Shop Drawings:

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

.4 Samples:

.1 Submit samples in accordance with Section 01 01 50 – General Instructions.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

## 1.5 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 01 50 – General Instructions.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 01 50 – General Instructions.

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

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

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

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## Part 2 Products

### 2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

### 2.2 INSULATION

.1 Mineral fibre 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 C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

### 2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

### 2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

### 2.5 VAPOUR RETARDER LAP ADHESIVE

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

### 2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

### 2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m5.

## 2.8 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: by Departmental Representative.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 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.

.8 Special requirements:

.1 Outdoor: UV rated material at least 0.5 mm thick.

.2 ABS Plastic:

.1 One-piece moulded type and sheet with pre-formed shapes as required.

.2 Colours: by Departmental Representative.

.3 Minimum service temperatures: -40 degrees C.

.4 Maximum service temperature: 82 degrees C.

.5 Moisture vapour transmission: 0.012 perm.

.6 Thickness: 0.75 mm.

.7 Fastenings:

.1 Solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Locations:

.1 For outdoor use ONLY.

.3 Canvas:

.1 220 gm/m5 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.4 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

.5 Stainless steel:

.1 Type: 316.

.2 Thickness: 0.25 mm.

.3 Finish: smooth.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

### 2.9 WEATHERPROOF MEMBRANE FOR INSULATION INSTALLED OUTDOORS

.1 Prefabricated, self-adhering, sheet-type waterproofing membrane: FlexClad-400 or approved alternative.

.1 Description:

.1 Top Layer: Stucco-embossed, UV-resistant aluminum weathering surface.

.2 Middle Layer: Double layer of high-density polyethylene reinforcement.

.3 Bottom Layer: Uniform layer of rubberized Caulking.

.2 Heat Aging, No visible blistering or deterioration.

.3 Tear Resistance, ASTM D 1424, Average: 660 grams.

.4 Elongation, ASTM D 412, Minimum: 450 percent.

.5 Low Temperature Flexibility, 1,000,000 cycles at –10°F, 1,200 cycles at –20°F: No cracking.

.6 Water Vapor Transmission, ASTM E 96: 0.009 perms.

.7 Flame Spread Index, ASTM E 84: 0.

.8 Smoke Density Index, ASTM E 84: 5.

.9 Wind-Driven Rain, SFBC TAS-110-95, 100 mph: No leakage or failure.

.10 UV Stability: Excellent.

.2 Application: All insulated pipework exposed to outdoors.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

## 3.2 PRE-INSTALLATION REQUIREMENT

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

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

## 3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and this specification. Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.4 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

## 3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valve, primary flow measuring elements flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: aluminum SS PVC ABS.

## 3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

## 3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.TIAC Code: A-1.

.1 Securements: bands Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.2 TIAC Code: A-3.

.1 Securements: bands at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.3 TIAC Code: A-6.

.1 Insulation securements

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code

.4 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.5 TIAC Code: A-2.

.1 Insulation securements:

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-H.

.6 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 | Pipe sizes (NPS) and insulation thickness (mm) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Run out | to <1 | 1<1 ½ | 1 ½ <4 | 4 to<8 | 8 & over |
| Refrigerant Hot Gas Liquid Suction & Chilled Water & Brine | 4-16 | A-6 | 25 | 25 | 25 | 25 | 25 | 25 |
| Refrigerant Hot Gas Liquid Suction & Chilled Water & Brine | below 4 | A-6 | 25 | 25 | 25 | 38 | 38 | 38 |
| Cooling Coil Condensate Drain | | C-2 | 25 | 25 | 25 | 25 | 25 | 25 |
| Steam | up to 175 | A-3 | 38 | 50 | 65 | 75 | 90 | 90 |
| Condensate Return | 60 - 94 | A-3 | 25 | 38 | 38 | 38 | 38 | 38 |

.7 Finishes:

.1 Exposed indoors: PVC jacket to match existing.

.2 Exposed in mechanical rooms: PVC jacket to match existing.

.3 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.4 Outdoors: water-proof aluminum jacket.

.5 Finish attachments: SS bands at 150 mm on centre. Seals: closed.

.6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

.8 INSTALLATION OF WEATHER-PROOF JACKETED INSULATION:

.1 Install sectional weather-proof jacketed pipe insulation in strict accordance with manufacturer's instructions to produce a water-tight weather-proof installation. Insulate fittings with blanket type glass fibre insulation of a thickness and insulating value equal to the sectional insulation and secured in place with adhesive and wire. Jacket fittings with manufactured aluminium fitting covers sealed water-tight. Insulate following pipe with weather-proof jacketed insulation:

**3.7 CLEANING**

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

END OF SECTION

## Part 1 General

### 1.1 REFERENCES:

.1 Section 01 01 50 – General Instructions

.2 Section 01 91 00 – Commissioning

.3 Section 26 05 00 – Common Work

### 1.2 GENERAL COMMISSIONING CONCEPT AND COMMISSIONING PLAN

.1 Commissioning Agent being hired by Contractor.

.2 The Commissioning as applied to buildings is the process of bringing a building into use concluding all activities directed to that end, and including equipment as well as staffing involved in the subject facility.

.3 Verification, as related to the Mechanical, Electrical and Specialty systems installed in the building, represents the process of proving the performance of the equipment as defined in the technical specifications.

.4 Owner shall retain and pay for Commissioning Authority, which manages and oversees the commissioning process.

.5 The Commissioning Plan (provided by the Commissioning Authority):

.1 Identifies the role of each participant in the Commissioning Process and maps out both overall and phase-specific strategies for the project.

.2 Describes the procedures for verification of each system.

.6 The Commissioning Process covers the full life cycle of the project from the initial planning activities through to the point where that facility is in full operation and in full compliance with predefined user, operator, design and contract requirements.

.7 The Commissioning Process includes the following five major components:

.1 Thorough documentation and monitoring of all facets of construction.

.2 Extensive tests of all subsystems, their components and controls.

.3 Testing of whole systems that include a multiple of subsystems.

.4 Specific and detailed training on all major equipment for operational personnel.

.5 Ongoing monitoring and checking during the warranty period.

### 1.3 OBJECTIVES

.1 Support quality management through monitoring and checking of the installation.

.2 Verify systems performance through inspection and performance testing of the completed installation.

.3 Move the completed facility from the "static completion" state to the optimal "dynamic" operating state.

.4 Optimize operating and maintenance through delivery of comprehensive quality training and instruction to the Owner's operating personnel.

.5 System debugging and optimization.

.6 Completion of training and instruction for the operating and maintenance personnel.

.7 Assure provision of accurate and useful historical records, such as "as-built drawings", test certificates etc. Such records provide important data for operating and maintaining the systems as well as for future system testing, maintenance or renovations.

.8 Completion of testing and verification through seasonal review.

.9 Specifically, the Commissioning Process shall deliver to the owner:

.1 A complete set of documentation on the design intent and maintenance requirements of each system involved in the commissioning process.

.2 A system that functions in accordance with the design intent.

.3 Operators who fully understand the design intent and the operation and maintenance requirements of the equipment.

**1.4 CONTRACTOR’S RESPONSIBILITIES**

.1 Start-up Phase

.1 Ensures that start-up program is implemented in accordance with the facility start-up requirements within the contract documents.

.2 Following start-up, which may be observed by the Owner/Departmental Representative/Commissioning Authority, and must therefore be pre-scheduled, begins Performance Testing under conditions which simulate varying load and all operating modes, including emergency modes of operation.

.3 Following contractor's thorough testing, schedules, and performs verification-related tasks in the presence of the Commissioning Authority.

.2 Post-Construction Phase

.1 Post construction commissioning is the continued adjustment, optimization and modification of the systems to meet specified requirements. It includes updating documentation to reflect minor set point adjustments, system maintenance and calibration, major system modifications and provision of ongoing training of operation and maintenance personnel.

.2 The objective of post construction phase commissioning is to maintain the performance of the systems throughout the useful life of the facility in accordance with the current design intent.

.3 Complete all commissioning procedures, activities, and performance verification, which were delayed or not executed during the construction phase.

.4 Executes system checks with the Owner/Departmental Representative/Commissioning Authority:

.1 Once during the first month of building operation.

.2 Once during the third month of building operation.

.3 Once between the fourth and tenth months in a season opposite to the first or third month visit.

.5 Completes rectification of all deficiencies revealed by the above checks.

.6 Revises all as-builts and operating and maintenance documents to reflect all changes, modifications, revisions and adjustments upon completion of commissioning.

**1.5 Standard of acceptance**

.1 Commissioning Agent services shall be performed by a separate independent company.

.2 Standard of acceptance:

.1 K.D. Engineering.

.2 Western Mechanical.

.3 Design Intent

**Part 2 Products**

**2.1 COMMISSIONING INVOLVEMENT**

.1 The Commissioning Authority shall direct, witness and verify equipment performance testing. Accordingly, the Contractor and/or his suppliers and/or his Independent Third Party Commissioning Agents shall perform the following:

.1 Check and ensure the installation of the systems and equipment to ensure that the installation is complete, is in a proper and safe state, has been pre-tested to ensure all complete and proper operation, and is ready for verification.

.2 Run and test the systems and equipment through their design parameters to verify their capabilities in performance, sequencing, safety protection and alarms annunciation.

**2.2 SYSTEMS TO BE COMMISSIONED**

.1 Mechanical systems shall include, but are not limited to, the following (Refer to Division 1 – General Commissioning (Cx) requirements):

.1 Hydronic heating systems.

.2 Air distribution systems.

.3 Direct expansion (DX) cooling / heating systems.

.4 Control systems.

**2.3 TESTING EQUIPMENT**

.1 The Contractor shall provide all instrumentation and test equipment necessary to conduct the tests specified during the commissioning process.

**2.4 DOCUMENTATION**

.1 Contractor shall record all test results and procedures on approved record forms, and submit the forms together with copies of test certificates to Departmental Representative and Commissioning Authority for review and approval.

.2 When the results are verified, the Commissioning Agent shall incorporate those records in his Systems Operations Manual. He shall also make entry of those test results into appropriate sections of the Operating and Maintenance Manual for reference.

## Part 3 Execution

### 3.1 COMMISSIONING PROCESS

.1 Perform and complete all works as specified in the Mechanical specifications. In general, it shall include complete activation of all systems; calibration; testing; verification of performance of all components, equipment and systems; verification of performance of all systems through all specified modes of control and sequences of operation, recording of test results for submission; demonstration, instruction and training of Owner's operating and maintenance personnel; and follow-up during the first year of operation for fine tuning and monitoring purposes.

.2 Advise the Owner/Departmental Representative/Commissioning Authority at least 3 days in advance of any test.

.3 Complete the testing form provided by the Commissioning Authority for each test, and submit copies to the Departmental Representative and Commissioning Authority.

### 3.2 TESTING OF MECHANICAL SYSTEMS – ADDITIONAL REQUIREMENTS

.1 Plumbing and Drainage System Testing

.1 The plumbing and drainage system shall be tested in accordance with the Plumbing Code under the National Building Code.

.2 The Contractor shall notify the Building Inspector when systems are available for testing. The Contractor shall document all tests performed and shall arrange for the Building Inspector to witness tests completed.

.3 Also perform hydrostatic pressure test for domestic hot and cold water systems.

.2 Water Treatment/Flushing of New Piping

.1 The Specialist shall complete the Manufacturers' testing forms and submit a report to the Departmental Representative and Commissioning Agent.

.2 The Specialist shall assist the Contractor in cleaning all new piping systems. The Specialist shall take samples and repeat the cleaning process if the specification requirements are not met.

.3 The specialist shall provide:

.1 Initial water analysis and treatment recommendations

.2 Start-up assistance

.3 All necessary laboratory services and technical assistance required

.4 During circulation of cleaning solutions, periodically examine and clean filters and screens and measure and monitor changes in pressure drop across equipment.

.5 The specialist shall revisit the site after one month of operation of each system and re-test the systems, and provide a report to the Departmental Representative and Commissioning Authority.

.6 Where multiple cut-ins are required into an existing system, the Specialist shall repeat the above steps, and report after the completion of each cut-in.

.3 Fire Protection

.1 The Contractor shall hydrostatically test the systems as per the specification and NFPA requirements to meet all certifications. The test shall be witnessed by the Departmental Representative and/or the Commissioning Authority. Provide a copy of the report in NFPA 13 and 14 reporting format for all such tests to the Commissioning Authority.

.2 The Contractor shall obtain approval certificates from the Authorities having Jurisdiction and submit copies of the certificates to the Commissioning Agent and Commissioning Authority for review.

.4 Piping Systems (Hydronic Circulation)

.1 Before testing, ensure that all installed valves and equipment are accessible for servicing and replacement, as per manufacturer's recommendations.

.2 Test all piping systems in accordance with all applicable Plumbing Codes.

.3 All other systems not covered by Codes noted above shall be tested and proven tight over a period of four (4) hours by a hydrostatic test. Remove fixtures, appliances, devices, vents and gauges and temporarily plug connections, as required. Provide temporary bypass when required.

.4 Repair any leaks or defects and repeat the tests to the satisfaction of the Departmental Representative.

.5 Complete the testing forms and forward copies of the test reports to the Departmental Representative and Commissioning Authority.

.6 After testing, TAB contractor shall measure the water flow at each existing reheat coil via the existing circuit setters. Submit report to the Departmental Representative and Commissioning Agent for review.

.7 The Contractor shall co-ordinate with the TAB Contractor and provides assistance during the balancing process. Review the complete installation with the balancing contractor, and provide a report stating that all systems can be balanced by the balancing contractor as per the design. Any concerns or discrepancies must be highlighted to the Departmental Representative and Commissioning Authority prior to installation. Notify the Departmental Representative and Commissioning Authority in writing that this coordination has taken place before installation begins. Additional costs related to the lack of proper type or location of balancing devices will be borne by the Contractor.

## 3.3 COMMISSIONING MEETINGS AND REPORTING

.1 The Contractor shall include all responsibilities noted in the commissioning specifications, including all tests, within his construction schedule.

.2 The commissioning meetings, as required by the Commissioning Authority, shall follow the regular construction meetings. The testing schedules and results of all tests shall be reviewed.

.3 All testing forms and reports associated with the mechanical systems shall be directed to the Commissioning Authority with copies to the Departmental Representative.

.4 The forms and reports to be issued shall include:

.1 Reviewed shop drawings

.2 Equipment verification/data forms

.3 Testing forms

.4 Reports resulting from tests

.5 Testing schedule

**3.4 OPERATING AND MAINTENANCE MANUAL**

.1 The Contractor shall prepare and submit the Operating and Maintenance Manual as detailed in the specification Section 01 01 50 – General Instructions.

.2 The Contractor shall re-submit the manual should the Departmental Representative find deficiencies. Training shall not begin until the manual has been accepted by the Departmental Representative.

.3 One (1) copy of the manual shall be forwarded to the Commissioning Authority in good quality, vinyl covered binders at the time of submission to the Departmental Representative. Four (4) final hard copies and 3 digital final copies of the manuals (after incorporating the Departmental Representative/Commissioning Authority comments) shall be submitted to the Commissioning Authority in 75mm (3") D-ring white vinyl covered binders with transparent sleeve.

.4 Each mechanical manual shall be organized as follows, but not limited to the following:

.1 Project Directory

.2 Plumbing

.3 Fire Protection

.4 Heating and cooling

.5 Ventilation

.6 Energy Monitoring and Controls System

.5 The project directory shall contain the names, addresses, fax numbers and telephone numbers of Contractors, Sub-Contractors, Manufacturers and Manufacturers representatives.

.6 Sections 3.4.4.2 to 3.4.4.6 noted above shall be divided into the following sub-sections.

.1 Shop drawings (reduced to 8½" x 11")

.2 As-built drawings (reduced to 8½" x 11")

.3 As-built riser diagrams (reduced to 8½" x 11")

.4 Systems description

.5 Operating procedures

.6 Maintenance procedures

.7 Trouble shooting guide;

.8 Valve chart (where applicable)

.9 Filter size chart (where applicable)

.10 Equipment lists

.11 Testing and verification forms

.12 Certification forms

.7 Systems description shall be a detailed description of each major component, describing the intent, function, operational modes, and any information that may be pertinent to day-to-day operation.

.8 The operating procedures, maintenance procedures, spare parts list, and troubleshooting guide shall be as recommended by the Manufacturer.

.9 The equipment list shall include make, model, serial number, electrical characteristics, RPM, pump impeller sizes, fan belt and sheave sizes.

## 3.5 OWNER DEMONSTRATION AND OPERATOR TRAINING

.1 Systems' demonstration shall be conducted by the Contractor. The demonstration shall cover all operation and maintenance requirements and a physical demonstration of equipment installation and operation.

.2 Owner demonstration shall include a walk-through of the building by the Contractor. During the walk-through, the Contractor shall:

.1 Identify equipment

.2 Identify starters associated with equipment

.3 Identify valves and balancing dampers

.4 Identify access doors

.5 Review general maintenance of equipment

.6 Review drain points in pipe work systems

.7 Identify maintenance items

.3 The Contractor and equipment Manufacturer shall provide operator training for each mechanical system and item of equipment.

.4 Training and instruction shall be provided by qualified Technicians and shall be conducted in a classroom setting and at the equipment or system.

.5 Training and instruction will begin after the Operating and Maintenance manual has been approved and delivered to the Departmental Representative.

.6 Each session shall be structural to cover.

.1 The operating and maintenance manual

.2 System description

.3 Operating procedures

.4 Maintenance procedures

.5 Trouble shooting procedures

.6 The Manufacturer's or Service Representative's name, address and telephone number

.7 Provide course documentation for up to six (6) people.

.8 Training and instruction shall be provided for the following systems wherever applicable:

.1 Life Safety & Fire Protection Systems

.2 Heating and Cooling Systems

.3 Building Automation & Controls Systems.

.4 Mechanical Systems

.5 Ventilation Systems

.9 Time Allocation

.1 The time allocation for various Owner training sessions is not predetermined. The agenda for training sessions will be outlined and agreed upon with the mechanical contractor and commissioning authority through the commissioning program to ensure the Owner receives adequate training.

## 3.6 TESTING FORMS

.1 The Contractor and Manufacturer shall provide testing and commissioning forms for review and acceptance.

.2 Mechanical testing and verification forms shall include, but are not limited to, the following:

.1 Equipment test form

.2 Piping pressure test form

.3 Test identification form

.4 Chemical treatment data sheet

.5 Fan data sheet

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

.1 23 05 05 Installation of Pipework.

.2 23 07 15 Thermal Insulation for Piping.

.3 23 73 12 Halocarbon Management

### 1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.22-01 (R2010), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.

.3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A 307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B 280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

.1 CSA B52S1-09/Supplement No.1 to B52-05, Mechanical refrigeration code.

.4 Environment Canada (EC)

.1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

## Part 2 Products

### 2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B 280, type K.

.2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

**2.2 FITTINGS**

.1 Service: design pressure 2070 kPa and temperature 121°C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 .3 Flanged:

.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.

.2 Gaskets: suitable for service.

.3 Bolts, nuts and washers: to ASTM A 307, heavy series.

.4 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

**2.3 PIPE SLEEVES**

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

**2.4 VALVES**

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

**2.5 Insulation**

.1 For refrigerant suction and hot gas lines throughout, ½" (12 mm) thickness for suction lines 35˚F (1.7˚C) and above and smaller than 2 ½" (65 mm) dia., ¾" (19 mm) thickness on all other lines.

.2 Materials to comply with CAN/CGSB-51-40.

.3 Attach using quick-setting contact adhesive along seams and joints, as recommended by the insulation manufacturer.

.4 All joints to be covered with self-adhesive PVC tape as recommended by the insulation manufacturer.

.5 Use waterproof aluminum jacket where exposed to sunlight to avoid UV deterioration.

**2.6 LIQUID INDICATORS**

.1 Liquid indicators shall be double port type with copper brass body, and flared or solder ends.

.2 Provide removable seal caps on each port to inspect refrigerant condition.

**2.7 STRAINERS**

.1 Refrigerant strainers shall be angle replaceable cartridge type with brass shell.

.2 Cartridge material and screen size shall be suitable for refrigerant and piping materials utilised in the system.

**2.8 HOT GAS REGULATOR**

.1 Sweat end, screw adjustment, integral electric shut off valve, or a separate electric solenoid shut-off valve upstream of hot gas regulator.

**2.9 FILTER-DRYERS**

.1 Combination filter-dryers shall be angle type, with brass shell and incorporate a combined straining and drying material.

.2 Desiccant material shall be replaceable.

**2.10 SOLENOID VALVES**

.1 Solenoid valves shall have copper or brass body with flared or screwed ends.

.2 Coil assembly shall be replaceable.

.3 Valves shall incorporate a manually operated stem to serve as a bypass in case of coil failure.

**2.11 EXPANSION VALVES**

.1 Provide angle type or straight through expansion valves suitable for the refrigerant utilised in the system.

.2 Valves shall have brass body, internal or external equaliser, adjustable superheat setting and be complete with capillary tube and remote sensing bulb.

**2.12 CHARGING VALVES**

.1 Provide general purpose type refrigerant charging valves with brass body, flared or solder ends and with removable valve core.

.2 Provide valve inlet with quick coupling connection for ease of charging.

**2.13 FLEXIBLE CONNECTORS**

.1 Flexible connectors shall consist of close pitch corrugated bronze hose with single layer of exterior braiding to provide additional strength and prevent elongation of corrugated section.

.2 Connectors shall be minimum 230 mm long and provided with bronze fittings to facilitate connection to equipment

## 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 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

### 3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

### 3.4 PIPING INSTALLATION

.1 General:

- .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Size lines to manufacturers and industry standards and recommendations.

.2 Hot gas lines:

- .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
- .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
- .3 Provide inverted deep trap at top of risers.
- .4 Provide double risers for compressors having capacity modulation.
  - .1 Large riser: install traps as specified.
  - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

### 3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

**3.6 MOUNTING**

.1 Mount refrigerant pipe in galvanized sheet metal wire way with lid for mechanical and environmental protection.

**3.7 LIQUID INDICATORS**

.1 Provide full size liquid indicators in main liquid line leaving condenser. If a receiver is used, install in liquid line leaving receiver.

**3.8 STRAINERS**

.1 Provide full size strainer ahead of each automatic valve. Where multiple expansion valves with integral strainers are used, install single main liquid line strainer.

.2 Provide shut-off valve at each side of strainer to facilitate maintenance.

**3.9 REFRIGERANT DRYERS**

.1 Provide full flow permanent refrigerant drier in low temperature systems and systems utilising hermetic compressors.

.2 Mount drier vertically in liquid line adjacent to receiver with three valve bypass assembly to permit isolation of drier for servicing.

**3.10 FILTER-DRYERS**

.1 Filter-dryers may be used in systems instead of separate strainers and dryers.

.2 Install with three valve bypass assembly to permit isolation for servicing.

**3.11 SOLENOID VALVES**

.1 Provide solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

.2 Provide solenoid valves with manually operable items.

**3.12 EXPANSION VALVES**

.1 Size expansion valves properly to avoid penalty of being undersized at full load and of being excessively oversized at partial load.

.2 Properly evaluate refrigerant pressure drop through system to determine the available pressure drop across the valve.

.3 Select valves for maximum load at design operating pressure and minimum 6°C of superheat.

.4 Locate remote expansion valve sensing bulb immediately after evaporator outlet and suction line.

## 3.13 CHARGING VALVES

.1 Provide refrigerant charging connections in liquid line between receiver shutoff valve and expansion valve.

## 3.14 FLEXIBLE CONNECTORS

.1 In general install suction and hot gas piping connections to compressors with three directional changes for distance of minimum six pipe diameters before reaching point of support.

.2 Flexible connectors shall only be utilised at or near compressors where it is not physically possible to absorb vibration within piping configuration.

## 3.15 START-UP AND COMMISSIONING

.1 Charge refrigerant, start-up and submit written report to Department Representative.

.2 Commissioning:

.1 In accordance with section 01 91 00 – Commissioning, and section 23 08 00 Mechanical Commissioning.

.3 Halocarbons Management:

.1 In accordance with section 23 05 00 Common Work Results - Mechanical.

.2 In accordance with section 23 73 12 – Halocarbon Management.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

.1 07 84 00 Firestopping.

.2 23 05 00 Common Work Results for HVAC.

.3 23 05 29 Hangers and Supports for HVAC Piping and Equipment.

### 1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM A480 / A480M-12 – Latest Edition, General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

.2 ASTM A635/A635M-09b – 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

.3 ASTM A653/A653M-11 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS)

.5 National Fire Protection Association (NFPA)

.1 NFPA-90A – Latest Edition, Installation of Air Condition and Ventilating Systems

.2 NFPA 90B – Latest Edition, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

.3 NFPA-96 - Latest Edition, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards – Metal and Flexible, 2005, 3rd Edition

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012, 2nd Edition

.3 IAQ Guideline for Occupied Buildings Under Construction 2007, 2nd Edition

.7 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34

## Part 2 Products

### 2.1 SEAL CLASSIFICATION

.1 Use SMACNA Seal Class “C” for all ductwork up to 500 Pa (2” w.g.) maximum operating pressure.

.2 Seal classification:

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

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.

### 2.2 SEALANT

.1 Sealant: water-based, polymer type flame resistant duct sealant. Temperature range of minus 5 degrees C to plus 93 degrees C (minus 23 degrees F to plus 200 degrees F).

### 2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

### 2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: standard radius or short radius with single thickness turning vanes.

.2 Round (where applicable): five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct or 45 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.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Use radiused elbows unless indicated otherwise.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

## 2.5 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to ASHRAE or SMACNA.

.3 Joints: to ASHRAE or SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

## 2.6 PRE-MANUFACTURED, PRE-INSULATED AND WATER-TIGHT OUTDOOR DUCTS

.1 Refer to Section 23 31 13.99.

.2 Application: All outside installed ductwork.

## 2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 00 Common Work Results for HVAC.

.1 Strap hangers: of same material as duct but one sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500 mm wide.

.2 Hanger configuration: to ASHRAE or SMACNA Standards.

.3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE or SMACNA Standards.

| 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.

.2 Supports for outdoor ductwork: In accordance with manufacturer requirement and seismically restrained. Refer to Section 23 31 13.99.

## Part 3 Execution

### 3.1 GENERAL

.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE and SMACNA Standards.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Insulate strap hangers 100 mm beyond insulated duct.

.4 Support risers in accordance with ASHRAE or SMACNA Standards.

.5 Install breakaway joints in ductwork on sides of fire separation.

.6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.7 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining where applicable.

.8 Coordinate ductwork installation with all other trades involved on this project. Optimize ceiling space in suspended ceilings and maintain maximum headroom under exposed ducts.

.9 Seal all joints in low pressure and high pressure. Apply sealant to outside of joint to manufacturer's recommendations. Bed tape into sealant and recoat with a coat of sealant. This applies to all supply, return, outdoor air and exhaust ductwork.

.10 Limit length of flex duct to 1500mm.

.11 Test all supply air and exhaust air ducts as recommended by SMACNA.

### 3.2 DUCTWORK EXPOSED TO ELEMENTS AND BURIED DUCTWORK

.1 Apply specified waterproofing membrane over properly prepared surfaces in accordance with manufacturer’s recommendations.

### 3.3 HANGERS

.1 Strap hangers: install in accordance with SMACNA Standards.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with ASHRAE or SMACNA Standards.

| Duct Size (mm) | Spacing (mm) |
|---|---|
| To 1500 | 3000 |
| 1501 and over | 2500 |

### 3.4 PRE-MANUFACTURED, PRE-INSULATED AND WATER-TIGHT OUTDOOR DUCTS

.1 Install per manufacturer’s requirement and approval. Refer to Section 23 31 13.99.

## 3.5 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 07 84 00 Firestopping.

.2 23 05 00 Common Work Results for HVAC.

### 1.2 SUMMARY

.1 Section includes:

1. Ducts and fittings for outdoor installation by Thermaduct, LLC, or approved equal.

### 1.3 SUBMITTALS

.1 Product data: For each type of product indicated.

.2 Shop drawings: Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.

1. Duct layout indicating sizes and pressure classes.
2. Elevation of top of ducts.
3. Dimensions of main duct runs from building grid lines.
4. Fittings.
5. Penetrations through fire-rated and other partitions.

.3 Coordination Drawings: Plans, drawn to scale, showing coordination general construction, building components, and other building services.

### 1.4 QUALITY ASSURANCE

.1 Installer Qualifications:

1. Ductwork can be installed per the current Manufacturer's Contractor Installation Manual by competent trained field mechanics who demonstrate competence in the HVAC industry.

### 1.5 SPECIFICATION COMPLIANCE AND REFERENCES

.1 Duct Leakage Class, follow SMACNA Leakage Class 3 or less.

.2 Duct shall incorporate a Kingspan KoolDuct fortified inner liner compliant to UL (C-UL) 181 Standard for Safety Listed, Class 1 system, with included testing and passing the following:

1. Test for Surface Burning Characteristics
2. Flame Penetration Test
3. Burning Test
4. Mold Growth and Humidity Test
5. Low Temperature Test and High Temperature Test

6. Puncture Test
7. Static Load Test
8. Impact Test
9. Pressure Test and Collapse (negative pressure) Test
10. High Temperature and Humidity for 90 days
11. Cone Calorimeter
12. ASTM E2257 Standard Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies
13. ASTM E 84 tested, Tunnel Test, Does not exceed 25 flame spread, 50 smoke developed.
14. DW144, Class B
15. NRTL product approval, (Subpart S of 29 CFR Part 1910, OSHA)
16. ASTM C 423 noise reduction
17. ASTM E 96/E 96M Procedure A for permeability
18. ASTM C 1071 for erosion
19. ASTM C 518: 2004, Standard Test Method for Steady–State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
20. UL 723, Test for Surface Burning Characteristics of Building Materials
21. NFPA Compliance:
    - .1 NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"
    - .2 NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems"
    - .3 NFPA 255, “Standard Method of Test of Surface Burning Characteristics of Building Materials

.3 Duct outer shell shall be a UV stable 1000 micron high impact resistant titanium infused vinyl with included testing as following;

1. UL-94 Flammability V-0
2. ASTM D-638 Tensile Strength of 6250 psi
3. ASTM D-790 Flexible Strength of 11,000 psi
4. ASTM D-4226 Drop Impact Resistance
5. ASTM D-4216 Cell Classification

## 1.6 PRODUCT DELIVERY AND STORAGE

.1 A. Prevent objectionable aesthetic damage to the outer surface of duct segments during transport and storage.

.2 Store duct segments under cover and protect from excessive moisture prior to installation.

## Part 2 Products

### 2.1 RECTANGULAR DUCT AND FITTINGS

.1 Product:

1. Thermaduct or approved equal.

.2 The panel shall be manufactured of CFC-free Kingspan Kooltherm closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, IR reflective 1000-micron high impact resistant titanium infused vinyl is factory bonded using a full lamination process. The lamination process shall permanently bond the vinyl clad to the outer surfaces of the phenolic foam panel to provide a zero-permeability water tight barrier and to form a structurally insulated panel (SIP) in which to form duct segments. Processes that do not employ a full lamination process are not acceptable. Self-applied adhesives such as tapes, caulks or cladding that incorporate pressure sensitive or spray adhesives are not acceptable.

.3 The thermal conductivity shall be no greater than 0.146BTU • in/Hr •ft2•°F (.018W/m•°C), the thermal conductivity shall be no greater than 0.146BTU • in/Hr •ft2•°F (.018W/m•°C)

.4 The density of the Kooltherm foam shall not be less than 3.5 pcf (56 Kg/m3) with a minimum compressive strength of 28 psi (.2 MPa).

.5 The standard panel is (31 mm) thickness panel with R-8.1 (1.5 RSI) shall be utilized unless indicated otherwise on the print.

1. Maximum Temperature: Continuous rating of 185 degrees F (70 deg C) inside ducts or ambient temperature surrounding ducts.
2. Maximum Thermal Conductivity: 0.146 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Permeability: 0.00 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
4. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
5. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
6. Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.
7. All insulation materials shall be closed cell with a closed cell content of >90%.
8. R-value:
   - .1 1 3/16 inch (31 mm) Thick Panel: 8.1 R
   - .2 1 ¾ (45 mm) Thick Panel: 12 R
   - .3 2 3/8” Double wall (62 mm) Thick Panel: 16.2 R
   - .4 3” Double wall (76 mm) Thick Panel: 20.1 R
   - .5 3.5” Double wall (100 mm) Thick Panel 24 R
9. Pressure Class design must be specified prior to fabrication. Duct shall be constructed to 4” (1000 Pa) pressure classes.

.6 Closure Materials:

1. V-Groove Adhesive: Silicone (interior only).
2. UV stable 1000 micron high impact resistant titanium infused vinyl (exterior).
   - .1 Factory manufactured seamless corners for zero perms.
   - .2 Cohesive bonded over-lap at corner seam covers for zero perms.
   - .3 Water resistant titanium infused welded vinyl seams.
   - .4 Mold and mildew resistant.
3. Polymeric Sealing System:
   - .1 Structural Membrane: Aluminum scrim with woven glass fiber with UV stable vinyl clad applied
   - .2 Minimum Seam Cover Width: 2 7/8” inches (75 mm)
   - .3 Sealant: Low VOC.
   - .4 Color: White (colors, matched by architect optional).
   - .5 Water resistant.
   - .6 Mold and mildew resistant.
4. Duct Connectors.
   - .1 Factory manufactured galvanized 4-bolt flange.

.7 Outdoor Cladding

1. Outdoor Installations: Duct segments shall incorporate UV stable 1000 micron high impact resistant titanium infused vinyl which is introduced during the manufacturing process.

.8 Flange coverings

.1 Flanges are field sealed airtight before flange covers are installed. Flange covering consists of the following:

1. Foam tape insulation with molded 39 mil covers.
2. Air gap (heating only application) with molded 39 mil covers.

.9 Reinforcement

1. Manufacturer shall provide designed and built with adequate reinforcement to both; withstand air pressure forces from within the duct from blower pressure and shall be built to handle expected snow load for the location where the ductwork is being installed. Manufacturer will employ Airtruss™ reinforcement system when both specified static pressure and duct sizes dictate the need. This is a factory installed system and no field installation of the reinforcement system is required.

.10 Weight

1. Ducts shall provide low weight stresses on the building framing and support members. Assembled duct shall have a weight of 0.86 lbs. per square foot to maximum weight of 2.7 lbs. per square foot (depending on R-value and reinforcement requirement). Hangers and tie-downs are to be detailed in the Contractor shop drawings for review prior to installation but not exceeding 13’ for duct girth <84” and 8’ for duct girth >85” between hangers and designed to carry the weight and wind load of the ductwork.

## Part 3 Execution

### 3.1 SHOP FABRICATION

.1 Certification:

Ducts shall be detailed and fully factory manufactured by an authorized manufacturer facility system. All fabrication labor will be certified “yellow label” building trade professionals, compliant to SMWIA and SMACNA labor guidelines (work preservation observed).

.2 Fabrication:

1. Fabricated joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to manufacturer’s written and detailed instructions.
2. Fabricated 90-degree mitered elbows to include turning vanes.
3. Fabricated duct segments in accordance with manufacturer’s written details.
4. Duct Fittings shall include 6 inches of connecting material, as measured, from last bend line to the end of the duct. Connections on machine manufactured duct may be 4 inches.
5. Fabricated duct segments utilizing v-groove method of fabrication. Factory welded or cohesively bonded seams will apply to fully manufactured ductwork and fittings. Internal seams will be supplied with an unbroken layer of low VOC silicone or bonding (for paint shop applications). Each duct segment will be factory supplied with either aluminum grip pro-file or pre-insulated duct connectors in accordance with manufacturer’s detailed submittal guide. Applied duct reinforcement to protect against side deformation from both positive and negative pressure per manufacturer’s design guide based on specified ductwork size and system pressure.
6. Designed and fabricated duct segments and fittings will be in accordance with “SMACNA Phenolic Duct Construction Standards” latest edition.
7. Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.
8. Duct shall be constructed to exceed requirements for snow and wind loads.

### 3.2 DUCT INSTALLATION

.1 Duct segments shall be installed per the Manufacturer Installation Manual by competent HVAC installers.

.2 Install ducts and fittings to comply with manufacturer’s installation instructions as follows:

1. Install ducts with fewest possible joints.
2. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
3. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
4. materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

5. Use prescribed duct support spacing as described in this specification and manufacturer's recommendations.

.3 Air Leakage: Duct air leakage rates to be in compliance with "SMACNA HVAC Air Duct Leakage Test Manual" latest version per applicable leakage class based on pressure.

## 3.3 HANGER AND SUPPORT INSTALLATION

.1 A. Contractor to ensure that the ductwork system is properly and adequately supported per the Manufacturer's Contractor Installation Manual.

1. Ensure that the chosen method is compatible with the specific ductwork system requirements per Manufacturer installation detail drawings. Pre-installation should be provided prior to work commencement by installing contractor for approval.
2. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

.2 Supports on straight runs of ductwork shall be positioned at centers not exceeding 13 feet (3.96 m) for duct sections when fabricated in 13 foot (3.96 m) lengths with duct girth less than 84". Larger duct sizes and short segments with duct girth greater than 84" are to be supported at 8 foot centers or less, in accordance with the Manufacturer Contractor's Installation Manual provided prior to work commencement.

.3 Ductwork shall be supported at changes of direction, at branch duct connections, tee fittings, parallel under turning vanes and all duct accessories such as dampers, etc.

.4 The load of such accessories to the ductwork shall be neutralized by the accessory support.

## 3.4 FIELD QUALITY CONTROL

.1 Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.

1. Remove and replace duct system where inspection indicates that it does not comply with specified requirements.

.2 Perform additional testing and inspecting, at the Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

## 3.5 DUCT SCHEDULE

.1 Outdoor Ducts and Fittings:

1. Thermaduct (or approved equal) Rectangular Ducts and Fittings:
   - .1 Minimum Panel Thickness: 31 mm
   - .2 Cladding: minimum 0.038 inch

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

.1 23 05 00 Common Work Results for HVAC

.2 23 05 93 Testing, Adjusting and Balancing for HVAC.

.3 23 31 13.01 Metal Ducts-Low Pressure to 500 Pa.

### 1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS)

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible, 95.

### 1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

## Part 2 Products

### 2.1 GENERAL

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

### 2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame 1.0 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

### 2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 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.

**2.4 TURNING VANES**

.1 Factory or shop fabricated single thickness and/or double thickness without trailing edge, to recommendations of SMACNA and as indicated.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 600 x 600 mm for person size entry.

.2 450 x 750 mm for servicing entry.

.3 300 x 300 mm for viewing.

.4 As indicated.

.2 Locations:

.1 Fire and smoke dampers.
.2 Control dampers.
.3 Devices requiring maintenance.
.4 Required by code.
.5 Reheat coils.
.6 Heat pumps
.7 Elsewhere as indicated.

.3 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

## 3.3 WORK FOR OTHER SECTIONS

.1 Install all motorized dampers, fire stats, thermostats, limit switches, sail switches, safety controls, and instrument wells required for control and alarm systems. Coordinate this work with Controls Coordinator.

.2 Provide pitot tube closures for TAB work. TAB contractor to locate closures to be installed by sheet metal contractor. Also install closures adjacent to all BMS duct mounted sensors.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

.1 23 05 00 Common Work Results for HVAC.

.2 23 05 93 Testing, Adjusting and Balancing for HVAC.

.3 23 31 13.01 Metal Ducts-Low Pressure to 500 Pa.

### 1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

### 1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 1 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate the following:

.1 Frame and blade material.

.2 Bearings.

.3 Adjustment quadrant.

## Part 2 Products

### 2.1 GENERAL

.1 Manufacture to SMACNA standards.

### 2.2 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

**2.3 MULTI-BLADED DAMPERS**

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 150 mm.

.4 Bearings: pin in bronze bushings.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage: 21 L/s/$m^2$ at 1000 Pa.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems, as required.

.4 Where integral dampers are specified for registers and grilles, also provide a separate balancing damper on the branch ducts.

.5 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.6 Dampers: vibration free.

.7 Ensure damper operators are observable and accessible.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

| | | |
|---|---|---|
| .1 | 23 05 00 | Common Work Results for HVAC. |
| .2 | 23 05 93 | Testing, Adjusting and Balancing HVAC. |
| .3 | 23 31 13.01 | Metal Ducts-Low Pressure to 500 Pa. |
| .4 | 23 33 00 | Air Duct Accessories. |
| .5 | 25 30 02 | EMCS Field Control Devices. |

### 1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM A635/A635M-09b – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

### 1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 1 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate the following:

.1 Performance data.

.2 Leakage test data pressure drop at listed airflow.

## Part 2 Products

### 2.1 MULTI-LEAF DAMPERS

.1 Opposed and/or parallel blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Performance:

.1 Leakage: in closed position less than 3cfm/ft$^2$ of rated air flow at 250 Pa differential across damper.

.6 Aluminum dampers:

.1 Provide for outside air and exhaust air systems.

.2 Blades and Frames: constructed from aluminum extrusions with internal hollows.

.7 Actuators by EMCS Contractor.

.8 Insulated blades for outside air dampers.

## 2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi and single leaf, aluminum construction with nylon bearings, centre pivoted, spring assisted or counterweighted, as indicated.

# Part 3 Execution

## 3.1 MANUFACTURER'S INSTRUCTIONS

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

## 3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

| | | |
|---|---|---|
| .1 | 23 05 00 | Common Work Results HVAC |
| .2 | 23 05 93 | TAB for HVAC |
| .3 | 23 31 13.01 | Metal Ducts - Low Pressure to 500 Pa. |

## Part 2 Products

### 2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

- .1 Full perimeter gaskets.
- .2 Plaster frames where set into plaster or gypsum board and as specified.
- .3 Concealed fasteners.

.3 Colour: as indicated.

### 2.2 MANUFACTURED UNITS

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

### 2.3 SUPPLY GRILLES AND REGISTERS

.1 Refer to Grilles and Diffuser schedule on drawings.

### 2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Refer to Grilles and Diffuser schedule on drawings.

### 2.5 DIFFUSERS

.1 General: flow straightening devices, blank-off quadrants and gaskets as indicated.

.2 Refer to Grilles and Diffusers schedule on drawings.

### 2.6 MAXIMUM SECURITY GRILLES

.1 General: Existing 254mm x 101.6mm grilles in the cell rooms shall be renovated to perforated supply and return grilles, as indicated on drawings.

.2 Furnish and install grilles face from 4.7mm thick face plate with 4.7mm diameter holes on 7.1mm staggered centers and with white two part polyurethane finish. Install as indicated on drawings and directed by Departmental Representative by using Security Sheet Metal or machine screws on 254mm maximum centres. Touch up damaged painted surfaces.

.3 Security bars in existing grillles shall be removed and the inner surface of grilles flange where the bars are welded shall be grind smooth and painted with the same paint and colour of the new face plate.

.4 Refer to and follow instructions of all sections of Division 2 to perform this work, including but not limited to, removing and exposure to building components containing hazardous materials.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible.

.3 Fit frames tightly to prevent leakage and smudging, and to completely cover openings.

.4 Furnish mounting frames to suit construction finish schedule, with concealed fastenings.

.5 Install grilles plumb with building lines, in alignment where several grilles occur in line, and centrally in ceiling tiles unless otherwise indicated.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 All Sections of Division 23 and 25.

### 1.2 REFERENCE STANDARDS

.1 ANSI/AHRI 430-10, Performance Rating of Central Station Air-Handling Units.

.2 Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.

.3 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.4 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings except Low-Rise Residential Buildings.

.5 NFPA 90 A&B – Installation of Air Conditioning and ventilation systems and installation of Warm Air Heating and Air Conditioning Systems.

.6 Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

.7 Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

.8 Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.

.9 Unit Energy Efficiency Ratio (EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

.10 Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL/ETL Canada label.

### 1.3 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 Follow manufacturer requirements for installation, rigging, moving, and unloading the unit at its final location.

.4 Storage and Handling Requirements:

.1 Store materials off the ground, and in accordance with manufacturer's recommendations in clean and dry.

.2 Store and protect air handling equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.5 Construction Waste Management in accordance with Section 01 01 50 – General Instructions.

## 1.4 SUBMITTALS

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

.2 Product data shall include dimensions, operating and shipping weights, capacities, certifications, ratings, fan performance, filter information, factory supplied accessories component performance, and electrical characteristics and connection requirements, casing construction details, wiring interconnections, gauges and finishes of materials, Installation, Operation and Maintenance manual with startup requirements.

.3 Provide all technical information relevant to the product being provided, including but not limited to all the information shown in the equipment schedules on drawings. It is the responsibility of the supplier to highlight any variances that his equipment has with the requirements of this specification whether or not pre-approval has been obtained. Provide the information in the same measurement units as indicated elsewhere in this specification.

.4 Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances, and connection details. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

.5 Provide fan curves (not fan tables), with specified operating points clearly plotted.

.6 Provide coil selection worksheets, clearly showing proper consideration for altitude, air density, and other corrections. Indicate coil tube fin and casing construction.

.7 Provide cabinet sound power levels.

## 1.5 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

.2 Include the following but not limited to: air volume, motor, fan, dampers, total heating, bearings, air and water side entering and leaving temperatures.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.2 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

## Part 2 Products

### 2.1 GENERAL

.1 Standard of acceptance: AAON, Trane, Engineered Air

.2 Units dimension and footprint should not exceed as shown on the drawings.

.3 Certify ratings: to ANSI/AHRI 430 with AHRI seal.

.4 Provide outdoor air handling unit in configuration as indicated on drawings and/or equipment schedules. Unit shall include all specified components and tested at the factory.

.5 Provide bell mouth for all inlet and outlet connections to have a radius curve equal to the thickness of the casing (i.e 50mm).

.6 The unit shall be designed to be supported by a housekeeping pad.

.7 Unit type as indicated on the schedule, having air tight components to meet all scheduled performance items including fan section with motor and VFD drive, economizer section, DX cooling coil, hot gas heating coil, compressors, air cooled condenser, dampers, filter section and unit controls.

.8 Unit shall be factory assembled and tested including leak testing of the coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the controls compartment’s literature pocket.

.9 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.10 Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.

.11 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.

.12 Installation, Operation and Maintenance manual shall be supplied within the unit.

.13 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment’s access door.

.14 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment’s access door.

## 2.2 AIR HANDLING UNITS CRAC-1 AND CRAC-2

.1 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

.2 Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929-11 for a minimum flash ignition temperature of 610°F.

.3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.

.4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.5 Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

.6 Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, condensers, and electrical and controls components shall be through hinged access doors with quarter turn, lockable handles. Full length stainless steel piano hinges shall be included on the doors.

.7 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

.8 Units with cooling coils shall include double sloped 304 stainless steel drain pans.

.9 Unit shall be provided discharge and return air openings as shown on drawings. Openings shall have upturned flanges of at least 1/2 inch in height around the opening.

.10 Unit shall include lifting lugs on the top of the unit.

.11 Unit shall include factory wired control panel compartment LED service lights.

.2 Electrical

.1 Unit shall be provided with standard power block for connecting power to the unit.

.2 Unit shall have a 5kAIC SCCR.

.3 Unit shall be provided with factory installed and field wired 115V, 20 amp GFI outlet in the unit control panel.

.4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more that 10% out of balance on voltage, the voltage is more that 10% under design voltage, or on phase reversal.

.3 Supply Fans

.1 Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

.2 Blowers and motors shall be dynamically balanced and mounted on rubber isolators.

.3 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

.4 Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

.5 Motor shall include shaft grounding.

.4 Cabinet Sound Power Levels: to be equal or better than indicated below.

| Octave Bands | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| Discharge LW (db) | 84 | 84 | 85 | 81 | 78 | 82 | 78 | 74 |
| Return LW (db) | 77 | 71 | 67 | 63 | 64 | 64 | 59 | 55 |

.5 Cooling Coils

.1 Evaporator Coils

.1 Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

.2 Coils shall have interlaced circuitry.

.3 Coils shall be helium or hydrogen leak tested.

.4 Coils shall be furnished with a factory installed expansion valves.

.2 Refrigeration System

.1 Unit shall be factory charged with R-410A refrigerant.

.2 Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.

.3 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.

.4 Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

.5 Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.

.6 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and factory installed liquid line filter driers.

.7 Unit shall include a variable capacity scroll compressor on the lead (all) refrigeration circuit(s) which shall be capable of modulation from 10-100% of its capacity.

.8 Unit shall include factory provided and installed compressor sound jackets on all compressors.

.9 Lead refrigeration circuit(s) shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

.3 Condensers

.1 Air-Cooled Condenser

.2 Condenser fans shall be vertical discharge, axial flow, direct drive fans.

.3 Coils shall be designed for use with R-410A refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.

.4 Heat pump outdoor coil shall be constructed of copper tubes with fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.

.5 Coils shall be designed for a minimum of 10 °F of refrigerant sub-cooling.

.6 Condenser fans shall be high efficiency electronically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.

.4 Filters

.1 Unit shall include 4 inch thick, pleated panel filters with an ASHRAE MERV rating of 14, upstream of the cooling coil. Unit shall also include 2 inch thick, pleated panel pre filters with an ASHRAE MERV rating of 8, upstream of the 4 inch standard filters.

.2 Unit shall include 1 inch aluminum mesh pre filters upstream of the outside air opening.

.3 Unit shall include a clogged filter switch.

.4 Unit shall include a Magnehelic gauge mounted in the controls compartment.

.5 Outside Air/Economizer

.1 Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return enthalpy activated fully modulating and (DDC) actuator. Unit shall include outside air opening bird screen, outside air hood and barometric relief dampers.

.6 Controls

.1 Factory Installed and Factory Provided Controller, fully integrated and factory programmed and tested to maintain room temperature set-point (input from room temperature sensor) at any time. Economizer shall control the room temperature setpoint first, DX cooling system second. If room relative humidity (RH) reaches above the RH high limit set point (input from room RH sensor), the dehumidification cycle shall activate to maintain the RH set point, and deactivate if the RH drops 5% (adjustable) below the setpoint.

.2 Unit Controller shall include BACnet interface for full communication with existing Building Management System (BMS).

.3 Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.

.4 Controller shall be capable of standalone operation with unit configuration, set point adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.

.5 Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.

.6 Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.

.7 Constant Volume Controller

.1 Unit shall modulate cooling with constant airflow to meet space temperature set point.

.2 With modulating hot gas reheat, unit shall modulate cooling and hot gas reheat as efficiently as possible, to meet space humidity loads and prevent supply air temperature swings and overcooling of the space.

.8 Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.

This controller will be installed in the CER room (see mech drawings) and shall be capable of communication with the facility BAS system thru BACnet interface.

.9 Unit controller shall be capable to interface with standby air handler controller to offer a duty/standby operation between the two units. In the event of a unit failure, the standby unit will start operation and the lead unit will shut down. Duty and Standby unit to be automatically switched every week to equalize unit runtime. Refer to Section 25 90 01 Sequence Of Operation for Duty/Stand-by operation governed by the facility DDC system.

.10 Supplier to coordinate with the controls contractor for the required programming of the DDC system and interacting with the unit controller for the intended controls and alarms.

## 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 air handling equipment 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 Provide appropriate protection apparatus.

.2 Installation, Operation and Maintenance manual shall be supplied with the unit.

.3 Installing contractor shall install unit, including field installed components, in accordance with manufacturer's Installation, Operation and Maintenance manual instructions.

.4 Ensure adequate clearance for servicing and maintenance.

.5 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in section 23 05 48 – Vibration and Seismic Control for Ductwork, Piping and Equipment.

.6 Any roof and wall penetrations are to be thoroughly sealed to ensure the water tightness and integrity of the entire floor.

.7 Install units on a flat surface level within 3.2 mm (1/8”) and of sufficient strength to support the units.

.8 Provide components furnished as per manufacturer’s literature.

.9 Provide certified wiring schematics to the electrical division for the equipment and controls.

.10 Provide all necessary control wiring as recommended by the manufacturer.

### 3.3 START-UP AND COMMISSIOING

.1 Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

.2 Commissioning

.1 In accordance with section 01 91 00 – Commissioning and section 23 08 00 – Mechanical Commissioning.

### 3.4 WARRANTY

.1 Provide warranty of the units that covers a period of 1 year from substantial completion.

## 3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 50 – General Instructions.

.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 01 50 – General Instructions.

END OF SECTION

## Part 1.0 General

### 1.1 HALOCARBONS

.1 Comply with all of:

.1 Federal Halocarbon Regulations, 2003;

.2 Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems (the Environment Canada "Refrigeration Code of Practice") Cat. No.: En14-207/2015E-PDF. April, 2015.

.2 Work on Halocarbon Systems includes installation, servicing, leak testing, charging and/or decommissioning of a refrigeration system or an air-conditioning system or doing any other work on the system that may result in the release of a halocarbon.

.3 All work on Halocarbon Systems shall be carried out only by a "Certified Person" as defined by the Federal Halocarbon Regulations 2003.

.1 Provide copies of all technicians' certificates to the Departmental Representative.

.4 Halocarbons listed under Item 1 through 10 of Schedule 1 of Federal Halocarbon Regulations, 2003 (SOR/2003-289) are <u>not</u> acceptable refrigerants for any new installations.

.5 Document **all** work on Halocarbon Systems using CSCs halocarbon form "**Information Required for Refrigeration Systems at Federal Correctional Facilities**". Obtain the latest form from Departmental Representative. Affix the completed form to equipment, and submit a copy of the form to Departmental Representative.

.6 Comply with the following timelines:

.1 Upon delivery of halocarbon-containing equipment to site, submit the following information to Departmental Representative within 24 hours of service;

.1 Equipment Location
.2 Make
.3 Model #
.4 Serial #
.5 Type of halocarbon
.6 Halocarbon charging capacity of system (kg or lbs)
.7 Factory Halocarbon Charge (kg or lbs)
.8 Cooling capacity (kW, Btuh, or Tons)

.2 Leak-test factory-charged halocarbon-containing equipment containing over 10kg of refrigerant in accordance with the Refrigeration Code of Practice within one week of equipment delivery to site.

.3 Leak-test field-charged halocarbon-containing equipment in accordance with Section 4.4 of the Refrigeration Code of Practice at the time of field charging of system.

.4 For all work on Halocarbon Systems, submit forms to Departmental Representative within 48 hours of work.

.5 For release of halocarbons >10 kg and <100 kg, submit forms to Departmental Representative within 24 hours of discovery of release.

.6 For release or potential release of halocarbons > 100 kg, submit forms to Departmental Representative **immediately**.

.7 Conduct annual leak tests of halocarbon-containing equipment with 19kW (5.4 tons) or greater cooling capacity in accordance with the *Federal Halocarbon Regulations, 2003* until such time as Interim Certificate of Completion is issued.

END OF SECTION

## Part 1.0 General

### 1.1 SUMMARY

.1 Related Sections:

1. Division 1
2. Section 23 05 00 Common Results for HVAC
3. EMCS control System: Division. 25
4. Electrical service and connections: Division 26

### 1.2 REFERENCES

.1 Certifications:

1. ETL, C-ETL

### 1.3 SUBMITTALS

1. Comply with Submittal Procedures and Execution and Closeout Requirements in General Requirements.

2. Submit product data (manufacturer's specifications and technical data including performance, construction and fabrication) for each manufactured component.

3. Product shall be warranted to be free from defects in materials and fabrication for a period of two years after installation or 27 months from ship date.

### 1.4 DELIVERY AND STORAGE

1. Deliver all materials in the original manufacturer's name and identification of the product.

## Part 2.0 Products

### 2.1 PRODUCTS

1. System: Humidification system shall include a steam generator, steam dispersion assembly, control equipment, and accessories.

    1. Steam generator shall be a DriSteem Vapormist electric evaporative steam humidifier or approved equal.
    2. Dispersion assembly shall be DriSteem Single dispersion tube(s) or approved equal. Alternates shall be considered in accordance with Div-1 requirements.
    3. Standard of acceptance- Humidifier and Dispersion Tube: DriSteem, Nortec, Pure Humidifier Co.

### 2.2 FABRICATION REQUIREMENTS

1. Tank construction material shall be cleanable 304-stainless steel with welded seams.

2. Tank cover shall have gasketed flanges and shall be removable, allowing easy access to tank components.

3. Drain connections shall have unions to allow convenient removal of the tank for cleaning.

4. Steam outlet on top of the steam cylinder shall allow a hose connection for connecting humidifier to dispersion tubes.

5. Immersion heater(s) shall be Incoloy-alloy-sheathed, resistance-type heater element designed for no more than 86 watts per square inch. Both threaded ends of each heater element shall pass through the top of the tank and be secured and sealed with washer and threaded nuts.

6. Over-temperature switch: Humidifier shall have a UL-listed limit control sensor with manual reset that shall sense an over-temperature condition and de-energize heater circuit control.

7. Over-temperature switch shall be factory mounted and equipped with connectors for field wiring.

8. Cleanable vaporizing chamber shall be 316 stainless steel with Heli-arc welded seams.

9. Water type, fill, and drain requirements:

    1. The humidifier shall be capable of generating steam from tap, softened or DI/RO water.

    2. Fill valve: Humidifier shall have a stainless steel electric solenoid-operated fill valve. Inlet water pressure shall be 25 to 80psi (172 to 552 kPa).

    3. Drain valve: Humidifier shall have an electric operated drain valve that shall drain automatically at the end of the humidification season.

10. Temperature sensor: Factory mounted sensor with a temperature range of -40 to 248 °F (-40 to 120°C) shall be mounted on humidifier to enable water temperature control.

11. Mounting, insulation, and enclosure:

    1. Enclosure shall be an 18-gauge stainless steel frame with resin cover suitable for finished spaces. Enclosure frame shall constitute a drip pan, having a threaded connection for drain piping. A separate compartment shall house electrical devices and shall be secured to prevent accidental contact with electrical components. The front exterior of the cabinet shall contain the microprocessor controller’s digital keypad.

    2. The humidifier frame shall have pre-punched keyhole-style mounting holes located on 16" (406 mm) centers for ease of wall mounting and leveling.

    3. Humidifier shall have factory installed 1" (25 mm) thick, rigid, foil-faced, fiberglass insulation.

    4. All surfaces including cover, bottom, and side with drain and overflow shall have insulation.

## 2.3 HUMIDIFIER CONTROLS

1. Controller shall be a Vapor-logic microprocessor controller with the following features or capabilities:

    1. Humidifier shall have an electronic power controller, surface mounted and wired in humidifier control cabinet assembly to regulate current to humidifier load. This regulation will modulate between 0% to 100% of maximum capacity

2. Humidification steam output control: Controller shall have the capability to provide fully modulating (0% to100%) control of humidifier outputs.
3. Keypad/display: Keypad/display shall be operable within a temperature range of 32 to 158 °F (0 to 70 °C) and shall provide backlighting for viewing in low light.
4. Removable touchscreen display shall be factory mounted on humidifier.
5. Keypad/display shall be capable of remote mounting and have a 50' (15 m) cable, or as required to be installed remotely.
6. Keypad/display shall be installed remotely adjacent to the humidifier. Coordinate the location with the mechanical consultant.

2. Web interface/server: Web interface and server shall have the same functionality as the Vapor-logic keypad/display and in addition:
   1. Web interface shall allow multiple remotely located users to simultaneously view system operation and/or change system parameters.
   2. Web interface shall have password-protected secure access.
   3. Web interface shall be compatible with standard internet browsers.
   4. Web interface shall connect directly to a personal computer or through a system network via Ethernet cable. Automatic cable configuration shall allow straight-through or crossover cables.
3. Controller shall be interoperable with any BACnet® network.
4. Controller shall provide redundant over-temperature safety control.
5. Controller shall provide PID control capability with field-adjustable settings.
6. Tap or softened water level control: Controller shall have the capability to provide water level control for softened or hard water, including automatic refill, low water cutoff, field-adjustable skim time functions, and automatic drain-down of humidifier after a user-defined period of inactivity (may require additional equipment).
7. Water temperature: Controller shall monitor tank temperature and:
   1. Maintain the evaporating chamber water temperature above freezing
   2. Maintain a user-defined preset evaporating chamber water temperature
   3. Allow rapid warm-up of water in evaporating chamber after a call for humidity, providing 100% operation until steam production occurs
   4. Tank temperature sensor shall provide backup over-temperature protection for the over-temperature switch.
8. USB port on the control board shall allow software updates, data backups, and data restoration
9. Up-time optimizer function shall keep humidifier(s) operating through conditions such as fill, drain, or run-time faults, as long as safety conditions are met, minimizing production down-time
10. Real-time clock shall allow time-stamped alarm/message tracking and scheduled events
11. Humidifier and control board shall be factory commissioned, including system configuration as-ordered.

12. Alarms, unit configuration, and usage timer values shall remain in nonvolatile memory indefinitely during a power outage.

13. Controller shall have the capability to monitor, control, and/or adjust the following parameters:

    1. Relative humidity (RH) set point, actual conditions in the space (from humidity transmitter), RH offset
    2. Dew point set point, actual conditions in the space (from dew point transmitter), dew point offset
    3. User-settable demand signal from a humidistat or building management system (BMS), 0-100% modulation: 0-10 Vdc, 4-20 mA
    4. Relative humidity (RH) duct high limit set point (switch) and actual conditions
    5. Relative humidity (RH) duct high limit set point, actual conditions (from transmitter), high limit span, and high limit offset
    6. Total system demand in % of humidifier capacity
    7. Total system output in lbs/hour (kg/h)
    8. Drain/flush duration, allowed days, and frequency based on usage
    9. End-of-season drain status and hours humidifier is idle before end of season draining occurs
    10. Window glass surface temperature with programmable offset
    11. Air temperature or other auxiliary temperature monitoring with programmable offset
    12. System alarms and system messages, current and previous
    13. Adjustable water skim duration
    14. Programmable outputs for remote signaling of alarms and/or messages, device activation (such as a fan), or for signaling tank heating and/or steam production
    15. System diagnostics that include:
        1. Test outputs function to verify component operation
        2. Test humidifier function, by simulating demand to validate performance
        3. Data collection of RH, air temperature, water use, energy use, alarms, and service messages for viewing from the keypad/display or Web interface
        4. Service notification scheduling
        5. Password-protected system parameters
        6. Keypad/display or Web interface displays in English, French, or German languages
        7. Numerical units displayed in inch-pound or SI units
    16. Control cabinet, subpanel, and access:
        1. Control cabinet type shall be NEMA-12.
        2. Control cabinet shall be shipped loose.

17. Modulating high limit control: Modulating high limit control system shall include a modulating electronic humidity transmitter (duct-mounted downstream from humidifier). It shall transmit to the microprocessor controller to modulate humidifier output and maintain the highest desired space humidity possible, at all airflow volumes, without saturation of the airstream. (For this application, it is recommended to use a sail type airflow-proving switch.)

18. Airflow proving switch, pressure type: Airflow proving switch shall be diaphragm-operated with pitot tube for field installation. Switch shall have an adjustable control point range of 0.05" to 12" wc (12.5 to 2988 Pa) Operating temperature range -40 to 180 °F (-40 to 82 °C). Compatible with 24, 120, and 240 VAC.

14. Control contractor shall coordinate with humidifier supplier for installation of the control component as listed above, control inputs from BAS and alarm outputs to BAS and local alarm panel. Refer to Section 25 90 01- Sequence of Operation for details.

## 2.4 SINGLE STEAM DISPERSION TUBE

1. Dispersion assembly shall disperse evaporative, non-pressurized humidification steam into ducted or open spaces.

2. Condensate management: Condensate shall return to the steam generator by pitching dispersion tube minimum (10%) or as instructed by manufacturer, toward steam generator.

3. High-efficiency dispersion:

    1. Dispersion tubes shall be insulated with a plenum-approved insulating material for in-duct installation and have an R-value not less than 0.5 at a thickness not more than 0.125" (3.2 mm), for minimal increase in dispersion tube diameter.

    2. Airstream heat gain shall not exceed the values as scheduled; the values shall be supported by the manufacturer's published data.

    3. Insulating material shall meet the following criteria at 0.125" (3.2 mm) thickness:

        1. Fire/smoke index shall be 0/0 per any of the following test procedures:

            1. UL 723 fire/smoke index (Test for Surface Burning Characteristics of Building Materials)
            2. NFPA 255 (Standard Method of Test of Surface Burning Characteristics of Building Materials)
            3. ASTM E84 (Surface Burning Characteristics for Materials Used in Plenums)
            4. Stable up to 300 °F (148 °C) continuous — to prevent material degradation, hardening, or crumbling at high temperatures
            5. Closed-cell construction that does not absorb water or support microbial growth — to negate the need for vapor barriers and jackets
            6. Non-toxic and pure as documented in manufacturer's data — to prevent off-gassing and to facilitate use in clean rooms, pharmaceutical applications, and food industries
            7. Will not degrade when exposed to UVC light — to negate the need for UV wraps

    4. Continuous, seam-welded, and held in place without bands or clamps to minimize surfaces for the accumulation of particulate matter

5. Absorption:
    1. Dispersion assembly shall provide absorption characteristics that preclude water accumulation on any in-duct surface within 28" (700 mm) of the humidifier tube panel while maintaining conditions in the duct airstream noted in the Humidifier Schedule drawing.
6. Fabrication and components:
    1. Single dispersion tube shall be constructed of 304 stainless steel with welded seams and have uniformly spaced tubelets for steam dispersion.
    2. Each tubelet shall extend through the wall of the dispersion tube and incorporate a properly sized calibrated orifice.
    3. Tubelets shall be constructed of high-temperature resin
7. Dispersion tube(s) shall extend the width of the duct.
8. Two-piece escutcheon plate shall be provided for sealing the duct opening around each dispersion tube.

## Part 3.0 Execution

### 3.1 EXECUTION

1. Installation: Install per manufacturer’s printed instructions and as indicated on drawings.
2. Coordinate electrical connections as specified in Division 26.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

.2 Related Sections:

.1 Section 01 01 50 – General Instructions.

.2 All sections of Division 23

.3 The existing CER is equipped with a BACnet-based Delta Controls (By ESC Automation) DDC system. All newly added software, graphics and hardware required for proper operation of existing and new equipment shall be fully compatible with the existing system. Contractor shall carry out an inventory and condition assessment of the existing control system prior to commencement of the contract. Responsibility for any subsequent failures of the existing system being modified by this contractor will rest solely with this contractor for the duration of the contract.

.4 All new DDC controllers shall be BACnet, controlled and programmable from the existing Delta frontend. Provide software and graphics upgrade complete with full documentation for software and equipment.

.5 Provide, install, calibrate, program and commission the DDC control system to achieve the performance specified in the following clauses. Refer to Section 01 01 50-General Instructions for requirements including scheduling and phasing responsibilities by the contractors including sub-contractors.

.6 Retain base building control contractor (ESC Automation) for this project.

### 1.2 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5- 1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

.1 ANSI/IEEE 260.1- 1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE STD 135- R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1- 89(R1995), Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).

.1 CEA-709.1- B-2002, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1- 1958 , Light Gray Colour for Indoor Switch Gear.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

## 1.3 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level.

.2 AI - Analog Input.

.3 AIT - Agreement on International Trade.

.4 AO - Analog Output.

.5 BACnet - Building Automation and Control Network.

.6 BC(s) - Building Controller(s).

.7 BECC - Building Environmental Control Center.

.8 CAD - Computer Aided Design.

.9 CDL - Control Description Logic.

.10 CDS - Control Design Schematic.

.11 COSV - Change of State or Value.

.12 CPU - Central Processing Unit.

.13 DI - Digital Input.

.14 DO - Digital Output.

.15 DP - Differential Pressure.

.16 ECU - Equipment Control Unit.

.17 EMCS - Energy Monitoring and Control System.

.18 HVAC - Heating, Ventilation, Air Conditioning.

.19 IDE - Interface Device Equipment.

.20 I/O - Input/Output.

.21 ISA - Industry Standard Architecture.

.22 LAN - Local Area Network.

.23 LCU - Local Control Unit.

.24 MCU - Master Control Unit.

.25 NAFTA - North American Free Trade Agreement.

.26 NC - Normally Closed.

.27 NO - Normally Open.

.28 OS - Operating System.

.29 O&M - Operation and Maintenance.

.30 OWS - Operator Work Station.

.31 PC - Personal Computer.

.32 PCI - Peripheral Control Interface.

.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.

.34 PID - Proportional, Integral and Derivative.

.35 RAM - Random Access Memory.

.36 SP - Static Pressure.

.37 ROM - Read Only Memory.

.38 TCU - Terminal Control Unit.

.39 USB - Universal Serial Bus.

.40 UPS - Uninterruptible Power Supply.

.41 VAV - Variable Air Volume.

## 1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.3 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

**1.5 SYSTEM DESCRIPTION**

.1 Refer to existing control system documents.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers.

.2 Control devices as listed in I/O point summary tables.

.3 Data communications equipment necessary to effect EMCS data transmission system.

.4 Field control devices.

.5 Software/Hardware complete with full documentation.

.6 Complete operating and maintenance manuals.

.7 Training of personnel.

.8 Acceptance tests, technical support during commissioning, full documentation.

.9 Wiring interface co-ordination of equipment supplied by others.

.10 Miscellaneous work as specified in these sections and as indicated.

.11 Removal of existing pneumatic controls components and tubing which are being replaced / upgraded to DDC and no longer be required for service.

.12 Retain an electrical sub-contractor to provide electrical work as covered in Division 26 as an integral part of the Division 25 sub-contract. Refer to Division 26 documents and coordinate scope with Division 26 sub-contractor.

.13 Line voltage power required for controls from dedicated circuits determined on site by Controls Contractor.

.14 Reinstate all existing fire alarm / smoke detectors interlocks with air handling equipment.

.15 Balancing work as required to setup the DDC systems and to match existing operating conditions.

.16 Firestopping for new penetrations through existing fire rated assemblies. Refer to Section 07 84 00 – Fire Stopping.

.3 Design Requirements:

.1 Design and provide conduit and wiring linking elements of system.

.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.

.3 Location of controllers as reviewed by Departmental Representative prior to installation.

.4 Provide utility power to EMCS as required.

.5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:

.1 Provide English operator selectable access codes.

.2 Use non-linguistic symbols for displays on graphic terminals.

.3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.

.4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English:

.1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

## 1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 01 50 – General Instructions.and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

.8 Existing devices intended for re-use: submit test report.

## 1.7 QUALITY ASSURANCE

.1 Have local office nearest to the project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.5 Health and Safety:

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

## 1.8 EXISTING CONDITIONS - CONTROL COMPONENTS

.1 Use new control wiring and piping.

.2 Provide new field control devices

.1 Provide for new, properly designed device.

.2 Departmental Representative should approve repair or replacing existing items judged defective yet deemed necessary for EMCS.

.3 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.4 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.

.5 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## 1.9 IDENTIFICATION, CALIBRATION AND PROGRAMMING

.1 Provide a written sequence of operation for each piece of equipment or system being controlled. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.

.1 Procedures for daily operation of the system.

.2 Theory of operation of the equipment.

.3 Theory of operation of the control program.

.2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.

.3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding controller number.

.4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well-documented print out of the controller program for review.

.5 At the time of the Owner's Demonstration and Instruction Period:

.1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.

.2 Submit CD's (including back-up diskettes) containing up to date copies of the programs in each controller.

.3 Submit (4) CD's with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)

.4 Provide the original software diskettes and the users' manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and desktop computer the software has been installed on.

.5 The controls contractor shall be responsible for registering all software with the manufacturer in the owner's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.

.6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:

.1 A report indicating all work performed.

.2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.

.3 Update printed and diskette copies of any changes made to programs for any controller.

.7 Provide one day of on-site instruction to the Owner's operating personnel during the first year of operation, scheduled as requested by the Owner.

## Part 2 Products

### 2.1 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to ASHRAE STD 135.

.2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

**2.2 ADAPTORS**

.1 Provide adaptors between metric and imperial components.

**Part 3 Execution**

**3.1 MANUFACTURER'S RECOMMENDATIONS**

.1 Installation: to manufacturer's recommendations.

**3.2 I/O WIRING**

.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

.2 Use plenum rated cable where required.

.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

.4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.

.5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.

**3.3 POWER WIRING**

.1 Where required, provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer’s specification.

.2 Each building controller will have its own dedicated power supply. No other controller or input/output device will be powered from this supply.

.3 Power wiring as per manufacturer’s specification.

**3.4 ENCLOSURE AND CONDUIT**

.1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

.2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

.3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

.4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.

.5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.

.6 Provide tamperproof screws to new and relocated equipment, controls enclosures and devices which are located in inmate accessible areas. Tamperproof screws shall be stainless TORX with pin.

.7 Wiring is to be in EMT conduit with set screw metal fittings in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All conduits shall be piped smoothly and neatly following building lines. Wiring above existing ceilings and wall cavities may be run free-air.

.8 Exposed conduits located in areas where inmates have access shall comply with the following security measures:

.1 Use two-hole straps.

.2 Install straps within 100mm of device boxes.

.3 Install straps within 100mm of both sides of fittings.

.4 Install straps at a maximum spacing of 500mm.

.5 All fittings steel.

.6 Keep conduit close to the wall and avoid spaces behind the conduit

.7 Route conduit along top of walls where possible.

.9 Liquid-tight flexible conduit to be used for roof mounted equipment wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof roof equipment curb.

.10 All junction boxes will have covers properly and firmly affixed after installation completion.

.11 Control panels located in occupied areas for relays or other similar field devices shall be accessible and located above corridor ceilings. For areas accessible by inmates, provide security type access panels.

## 3.5 CONTROL SYSTEM COMMISSIONING

.1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.

.2 The contractor is to supply digital point and non-digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non-digital.

.3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.

.4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non-digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.

.5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

.6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Agent prior to the contractor's verification at least one months before the scheduled substantial completion of the project.

.7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative and Commissioning Agent in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.

.8 The Commissioning Agent is not to commence controls checks until the above documentation is received. The Control System Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Control System Supplier for the purchase price of the material.

.9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.

.10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Control System Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 00 - Commissioning and Section 23 08 00 - Commissioning of Mechanical Systems.

.11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

**3.6 Third Party BACnet Integration**

.1 Where third party systems are installed with a BACnet compatible control panel, it is the responsibility of this contractor to integrate the system into the DDC control system.

.2 The contractor shall map over BACnet points that made available in the third party panels and provide control for all BACnet points permitted by the third party panels.

.3 Integrate the third party system into the DDC sequence of operation. This includes scheduling, outdoor conditions (temperature and ambient lighting levels), alarms, and any other information required to operate, diagnose, and maintain the equipment.

.4 Provide a detailed graphical display(s) depicting the third party equipment. The graphical display(s) shall contain ALL points that were mapped over from the third party system.

**3.7 PAINTING**

.1 Painting: in accordance with Division 9 - Painting, supplemented and as follows:

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

.4 Paint unfinished equipment installed indoors.

**3.8 CLEANING**

.1 Proceed in accordance with Section 01 01 50 - General Instructions.

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

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and

.2 Control System (EMCS).

### 1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 23 05 00 – Common Work Results - Mechanical.

.3 Section 26 05 00 – Common Work Results for Electrical.

.4 Section 25 05 01 - EMCS: General Requirements.

### 1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### 1.4 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of local office.

.2 Description and location of installing and servicing technical staff.

.3 Location and qualifications of programming design and programming support staff.

.4 Location of spare parts stock.

.5 Names of sub-contractors and site-specific key personnel.

.6 Sketch of site-specific system architecture.

.7 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.

.8 Descriptive brochures.

.9 Sample CDL and graphics (systems schematics).

.10 Response time for each type of command and report.

.11 Item-by-item statement of compliance.

## 1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop to include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Detailed system architecture showing all points associated with each controller.

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Auxiliary control cabinet locations.

.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

## 1.6 DETAILED SHOP DRAWING REVIEW

.1 Submit detailed shop drawings after award of contract and before start of installation and include following:

.1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.

.2 Wiring diagrams.

.3 Piping diagrams and hook-ups.

.4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

.5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:

.1 Sensing element type and location.

.2 Transmitter type and range.

.3 Associated field wiring schematics, schedules and terminations.

.4 Complete Point Name Lists.

.5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.

.8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.9 Listing and example of specified reports.

.10 Listing of time of day schedules.

.11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.12 Type and size of memory with statement of spare memory capacity.

.13 Full description of software programs provided.

.14 Sample of "Operating Instructions Manual" to be used for training purposes.

.15 Outline of proposed start-up and verification procedures.

**Part 2 Products**

**2.1 NOT USED**

.1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

.1 Not Used.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

### 1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 23 05 00 – Common Work Results - Mechanical.

.3 Section 25 05 01 - EMCS: General Requirements.

.4 Section 26 05 00 – Common Work Results for Electrical.

.5 Section 25 05 02 – EMCS: Submittals and Review Process.

### 1.3 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### 1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 01 50 – General Instructions, supplemented and modified by requirements of this Section.

.2 Submit Record Documents As-built drawings Operation and Maintenance Manual in English.

.3 Provide soft copies and 6 sets of hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.

.2 Provide index to full volume in each binder.

.3 Identify contents of each manual on cover and spine.

.4 Provide Table of Contents in each manual.

.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

## 1.5 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings and manuals generated in Section 25 05 02 - EMCS: Submittals and Review Process and System Architecture and include:

- .1 Changes to contract documents as well as addenda and contract extras.
- .2 Changes to interface wiring.
- .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
- .4 Locations of obscure devices to be indicated on drawings.
- .5 Listing of alarm messages.
- .6 Panel/circuit breaker number for sources of normal/emergency power.
- .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports.
- .9 Basic system design and full documentation on system configuration.
- .10 Print out of graphics.
- .11 Print outs of as-built programs
- .12 All commissioning documentation including sign-offs
- .13 Record of training
- .14 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .15 Provide 2 complete sets of hard and soft copies prior to system or equipment tests and 4 complete sets at completion of the project plus one electronic copy.
- .16 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .17 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
  - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
  - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.18 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at each OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.19 Software to include:

.1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

.2 Detailed descriptions of program requirements and capabilities.

.3 Data necessary to permit modification, relocation, reprogramming and to permit software modules to respond to changing system functional requirements without disrupting normal operation.

.4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

.5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

.6 Software for each Controller and single section referencing Controller common parameters and functions.

.20 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.21 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.22 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

.2 Submit for final review by Departmental Representative.

## Part 2 Products

### 2.1 NOT USED

.1 Not Used.

## Part 3 Execution

### 3.1 NOT USED

.1 Not Used.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).
.2 Local Control Unit (LCU).
.3 Equipment Control Unit (ECU).
.4 Terminal Control Unit (TCU).

.2 Related sections:

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 30 02 - EMCS: Field Control Devices.

.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

### 1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE (2015), Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).

.1 C22.2 No.205, Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.

.1 MD13800, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

### 1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### 1.4 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

## 1.5 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug Terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA;

.2 0 - 10 V DC;

.3 100/10,000 ohm RTD input;

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.3 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.4 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.3 Mounting details as approved by Departmental Representative for ceiling mounting.

.5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.6 Provide surge and low voltage protection for interconnecting wiring connections.

**1.6 SUBMITTALS**

.1 Make submittals in accordance with Section 01 01 50 – General Instructions and Section 25 05 02 - EMCS: Submittals and Review Process.

.1 Submit product data sheets for each product item proposed for this project.

**1.7 MAINTENANCE PROCEDURES**

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

**Part 2 Products**

**2.1 MASTER CONTROL UNIT (MCU)**

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.1 MCU must support existing Proprietary Protocol.

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.

.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).

.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.

## 2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

## 2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.

.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

## 2.4 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Update existing initial programming of Controllers, as required for the work under this contract. Refer to Section 25 05 01 – General Requirements and 25 90 11 – Sequence of Operation.

.2 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.3 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

## 2.5 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.

.1 Display analog values digitally to 1 place of decimals with negative sign as required.

.2 Update displayed analog values and status when new values received.

.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.

.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

## 2.6 POINT NAME SUPPORT

.1 Maintain existing point naming convention.

## Part 3 Execution

### 3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

### 3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as directed by Departmental Representative.

.2 Provide necessary power from local 120V branch circuit panel for equipment. Refer to electrical drawings and coordinate with electrical contractor.

.3 Install tamper locks on breakers of circuit breaker panel.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System EMCS: transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.

Related Sections:

.1 Section 01 01 50 – General Instructions
.2 Section 25 05 01 - EMCS: General Requirements.
.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.4 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
.5 Section 26 05 00 - Common Work Results - Electrical.
.6 Section 26 27 26 - Wiring Devices.

### 1.2 REFERENCES

.1 American National Standards Institute (ANSI).

.1 ANSI C12.7, Requirements for Watthour Meter Sockets.
.2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Canadian Standards Association (CSA International).

.1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

### 1.3 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### 1.4 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process and Section 01 01 50 – General Instructions.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

**1.5 EXISTING CONDITIONS**

.1 Repair surfaces damaged during execution of Work to match the existing.

**Part 2 Products**

**2.1 GENERAL**

.1 Control devices of each category to be of same type and manufacturer, and be compatible with the existing system.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.

.3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

**2.2 TEMPERATURE SENSORS**

.1 General: to be resistance or thermocouple type to following requirements:

.1 Thermocouples: limit to temperature range of 200 degrees C and over.

.2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 150mm as indicated.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module.

.1 LCD display to show space temperature ed and temperature setpoint.

.2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.

.3 Jack connection for plugging in laptop personal computer for access to zone bus.

.4 Integral thermistor sensing element 10,000 ohm at 24 degrees.

.5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.

.6 Stability 0.02 degrees C drift per year.

.7 Separate mounting base for ease of installation.

.2 Room temperature sensors.

.1 Wall mounting, in slotted type covers having brushed stainless steel finish, with guard.

.2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.

.3 Outdoor air temperature sensors:

.1 Outside air type: complete with probe length 100 - 150mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13mm conduit, weatherproof construction in NEMA 4 enclosure.

## 2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

.3 Output signal: 4 – 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50 degrees C.

.10 Long term output drift: not to exceed 0.25% of full scale/ 6 months.

.11 Transmitter ranges: select narrowest range to suit application.

## 2.4 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.

.3 Input and output short circuit and open circuit protection.

.4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.

.5 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Accuracy: plus or minus 1 % of Full Scale.

## 2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

## 2.6 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC as required.

.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2% repetitive switching.

.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.7 Switches on steam and high temperature hot water service: provide pigtail syphon.

## 2.7 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 High temperature detection: manual reset .

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 degrees C.

.4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Room: for wall mounting on standard electrical box with or without protective guard as indicated.

.2 Duct, general purpose: insertion length = half way in the air stream.

.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.5 Strap-on: with helical screw stainless steel clamp.

## 2.8 ELECTROMECHANICAL RELAYS

.1 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120 V AC.

.4 Relay to have visual status indication

## 2.9 SOLID STATE RELAYS

.1 General:

.1 Relays to be socket or rail mounted.

.2 Relays to have LED Indicator

.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.

.4 Operating temperature range to be -20 degrees C to 70 degrees C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.

.7 Operational frequency range, 45 to 65 HZ.

.2 Input:

.1 Control voltage, 3 to 32 VDC.

.2 Drop out voltage, 1.2 VDC.

.3 Maximum input current to match AO (Analog Output) board.

.3 Output.

.1 AC or DC Output Model to suit application.

## 2.10 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## 2.11 CONTROL VALVES

.1 Body: globe style, characterized ball.

.1 Flow characteristic as indicated on control valve schedule equal percentage,

.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.3 Normally open or Normally closed, as required.

.4 Two or Three port, as indicated.

.5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.6 Packing easily replaceable.

.7 Stem, stainless steel.

.8 Plug and seat, stainless steel.

.9 Disc, replaceable, material to suit application.

.10 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Rangeability 50:1minimum.

.11 NPS 2 ½ and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

## 2.12 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signal: 0-10V DC or 4-20 mA DC.

.3 Positioning time: to suit application. 90 sec maximum.

.4 Fail to normal position as indicated.

.5 Scale or dial indication of actual control valve position.

.6 Size actuator to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.8 Minimum shut-off pressure: refer to control valve schedule.

## 2.13 PANELS

.1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity without adding additional cabinets.

.3 Panels to be lockable with same key.

**2.14 WIRING**

.1 In accordance with Division 26.

.2 For wiring in concealed ceiling spaces and under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 For exposed wiring, run in EMT conduit.

.4 Wiring must be continuous without joints.

.5 Sizes:

.1 Field wiring to digital device: #18AWG.

.2 Analog input and output: shielded #18 minimum solid copper stranded twisted pair.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

## 3.2 TEMPERATURE SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.4 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

## 3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

## 3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

## 3.5 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 25 05 01 – EMCS: General Requirements

### 1.2 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.2 Control Description Logic (CDL) for each system.

.3 Input/output Point Summary Tables for each system.

.2 Allow for sequence of operation modification during commissioning.

.3 All set points shall be adjustable.

.4 General

.1 Control contractor shall submit within the shop drawings submittal one whole sequence of operation covering the new & existing systems.

.2 Provide electrical actuators for dampers and valves controlled by DDC signal.

### 1.3 REFERENCES

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

## Part 2 Products

### 2.1 NOT USED

.1 Not Used.

## Part 3 Execution

### 3.1 SEQUENCE OF OPERATIONS

.1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.

.2 Sequencing of operations for systems as follows:

.1 Air Handling Units (CRAC-1 and CRAC-2)

.1 These two units operate as Duty and Stand-by.

.2 Units are equipped with factory supplied DDC controller to control all required operation of the units. The AHU controller shall communicate with existing Delta Control DDC panel (by ESC Automation) and the facility BAS system. The unit DDC controller shall control the unit to maintain the room temperature set-point and high limit Relative Humidity (RH) setpoint. Refer to Section 23 73 11 (Air Handling Units) for details. Coordinate with the AHUs supplier for the control requirements and programming for the system to operate as intended.

.3 The unit shall run continuously. Provide the following control inputs and/or monitoring actions to the AHU controller:

.1 Enable/disable

.2 Room Temperature Set point reset 24 °C (75 °F), adjustable)

.3 Room High Limit RH Set point reset (57%, adjustable)

.4 Monitor each unit fan operation,

.5 Monitor each AHU General Fault.

.4 Calculate room dewpoint temperature corresponding to the room temperature and room relative humidity (RH) and display on the facility BAS display. Provide audio/visual alarm on BAS if dewpoint temperature is above 15 °C (59 °F) or below 5.6 °C (42 °F).

.5 Monitor Room Temperature on BAS.

.6 Alternate duty/stand-by units in weekly basis.

.1 Open the stand-by unit supply and return dampers.

.2 Stop the duty unit and close the relevant supply and return dampers.

.3 Start the Stand-by unit.

.4 If the stand-by unit did not hold operation for any reason, revert operation to the duty unit and generate audio/visual alarm on BAS.

.5 Provide fast acting damper actuators for the supply and return dampers of each unit.

.2 Humidifier (H-1)

.1 Humidifier is equipped with factory supplied controller with BACnet interface to control all required operation of the unit. The controller shall communicate with existing Delta Control DDC panel (By ESC Automation) and the facility BAS system. Coordinate with the Humidifier supplier for the control requirements, installation and programming for the system to operate as intended.

.2 When room relative humidity (RH) drops below 30% (adjustable), activate Humidifier to maintain the room RH at the set-point (30%, adjustable).

.3 Monitor room RH on BAS.

.4 Monitor Humidifier operation. Generate Visual/Audible alarm at BAS for malfunctions and general fault.

.3 Provide the following alarms on BAS:

.1 High room temperature above 27 °C (81 °F)

.2 Low room temperature below 18 °C (64 °F)

.3 Low RH below 30%

.4 Low Dewpoint Temperature below 5.6 °C (42 °F)

.5 High Dewpoint Temperature above 15 °C (59 °F)

.6 Stand-by Unit Failed

.7 General AHUs Fault

.8 General Humidifier fault.

.4 Provide an alarm indication panel in the adjacent Control Post with blinking Red LED lights for the following alarm indications. Tag the alarm lights accordingly:

.1 “High Room Temperature” when room temperature rises above 27 °C (81 °F)

.2 “Low RH” when room relative humidity drops below 30%

.3 “General AHU Fault”

.4 “CER in Fire”

.3 Fire Alarm Operation

.1 In case of a fire in the CER detected by the sprinkler system in the room, the Fire Alarm Panel shall communicate with existing Delta Control DDC panel (by ESC Automation) and the facility BAS system, thru which the AHU’s should be shut-off. A “CER in Fire” alarm shall be sent to BAS and the “Alarm Indication Panel” in Control Post.

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 Section 01 01 50.

.2 Reference to “Electrical Divisions” shall mean all related Electrical Sections and components including Division 26 and 28 in the Master Format Specifications.

.3 Reference to “Mechanical Divisions” shall mean all related Mechanical Sections and components including Divisions 23 and 25 in the Master Format Specifications.

.4 The word "Provide" shall mean "Supply, Install and Connect" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.5 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, and ensure coordination, establishing orderly completion and the delivery of a fully commissioned installation.

.6 The most stringent requirements of this and other electrical sections shall govern.

.7 All work shall be in accordance with the PROJECT Drawings and Specifications and their intents, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.8 Provide seismic restraints for all required equipment, piping and ductwork.

.9 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.

### 1.2 REFERENCES

.1 Install in accordance with CSA C22.1-2018 except where specified otherwise.

.2 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.

.3 Comply with other applicable standards.

### 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.

.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 SCOPE OF WORK

.1 Contractor shall supply, install, commission and provide warranty for a complete and fully documented electrical system as per contract drawings and specified herein. The Work includes all hardware, and services necessary to provide fully functional, coordinated electrical system. Refer to Section 01 01 50 for hours of work.

.2 Coordinate with Mechanical Div. 25 for all the demolition and installation work. Ensure safety.

.3 Perform work to upgrade existing AC and CU mechanical equipment in CER and upgrade existing electrical panel to new panel size to accommodate new equipment. Relocate light fixtures, conduits, fire alarm devices and any other electrical devices to accommodate new mechanical equipment's and associated duct work.

.4 Coordinate the exact location of the mechanical equipment with mechanical drawing package.

.5 Make sure no disturbance/hazard to existing equipment. Provide a cover to protect the communication panel while working on the MCC.

.6 Coordinate the outage in fire alarm systems with the facility during construction. Provide a verification of the duct smoke detector with the integrated system once it is commissioned with the new duct works.

.7 All drawings to be read in conjunction with existing reference drawings provided with the package and other disciplines drawings.

.8 Provide Quality Management (QM) services for the following:

.1 Project construction schedule

.2 Onsite testing and inspections of new and existing equipment

.3 Re-CSA certification of existing modified equipment

.4 Quality Management plan

.9 Component subsystems of the electrical system will include, but are not limited to the following:

.1 Connect exterior mechanical equipment via a system of interior surface mounted conduit. Equipment shall be connected to an existing distribution system.

.2 Connect interior mechanical equipment via surface mounted conduit. Equipment shall be connected to an existing electrical distribution system.

.3 Provide all required motor starters, associated control wiring and local disconnect switches.

.10 Provide grounding/bonding equipment as per CEC or as indicated in the contract drawings and specifications.

.11 Provide fire stopping as required.

.12 Perform commissioning in accordance with Section 01 01 50.

.13 As-built drawings and maintenance manuals.

.14 Seismic restraint for all electrical equipment and installations.

## 1.6 SUBMITTALS

.1 Submittals to be in accordance with Section 01 01 50.

.2 Submit shop drawings, product data and samples in accordance with Section 01 01 50. The submission shall be reviewed, signed and processed as described in Section 01 01 50.

.3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.

.5 Content

.1 Shop drawings submitted in accordance with Section 01 01 50.

.2 Data shall be specific and technical.

.3 Identify each piece of equipment.

.4 Identify the electrical rating for each equipment.

.5 Information shall include all scheduled data.

.6 Indicate the exact proposed model number for certain equipment.

.7 Advertising literature will be rejected.

.8 The project and equipment designations shall be identified on each document.

.9 Information shall be given in S.I. units

.10 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weight 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.

.6 Format

.1 Electronic copy (PDF format).

.2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.

.7 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.

.8 Keep one copy of shop drawings and product data, on site, available for reference.

.9 Quality Control: in accordance with Section 01 01 50

.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.

.10 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.

## 1.7 QUALITY ASSURANCE

.1 Quality Assurance in accordance with Section 01 01 50.

.2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians in accordance with authorities having jurisdiction.

.1 Employees registered in 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.

.4 Health and Safety Requirements in accordance with Section 01 01 50.

## 1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Section 01 01 50.

## 1.9 SYSTEM START-UP

.1 Refer to Section 01 01 50.

.2 Instruct the 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.

.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.

## 1.10 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.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## 1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

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

**1.12 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 Structural drawings.

.2 Consult the mechanical 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.

**1.13 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 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/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative and all affected parties.

.4 Contractor to read the drawings in conjunction with existing reference drawings and specifications to understand the intent of the work. Notify Departmental Representative if there is any discrepancies. No extra cost will be considered for any misunderstanding of work to be done.

.5 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.

### 1.14 SPRINKLER PROOF REQUIREMENTS

.1 In sprinklered 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.

### 1.15 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.

### 1.16 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01 01 50.

.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 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.

### 1.17 EXAMINATION

A site visit before the close of tender to be communicated with the Departmental Representative. No extra cost will be considered for any misunderstanding of work to be done.

.1 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specifications and the drawings, or in the drawings. 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.

### 1.18 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 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Departmental Representative **prior** to Tender closing. Failing this, the most expensive alternative is to be allowed for.

.3 The Contractor shall advise the Departmental Representative during the Tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Departmental Representative at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

.4 Advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

.5 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all new and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced and replaced if and when required. Advise the Departmental Representative of space problems before fabricating or installing any material or equipment. Demonstrate to the Departmental Representative on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Departmental Representative's written direction.

.6 Where electrical work and materials are noted as being provided by the Departmental Representative/PSPC or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

.7 Protect equipment and material from the weather, moisture, dust and physical damage.

.8 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/PSPC.

.9 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.

.10 Refinish damaged or marred factory finish to factory finish.

.11 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.

## 1.19 EQUIPMENT LIST

.1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the subtrades, 10 days after the award of the Contract.

.2 The equipment list shall be a full list of materials or systems intended for installation.

## 1.20 PROGRESS CLAIM AND CHANGE ORDER BREAKDOWNS

.1 Ten days after the award of contract, submit detailed progress claim breakdown for each division. Items to be included but shall not be necessarily limited to the following:

.1 Site services

.2 Distribution

.3 Feeders

.4 Branch circuit wiring, conduit and boxes

.5 Wiring devices

.6 Mechanical equipment and wiring

.7 Low tension

.8 Testing and commissioning

.9 As-built drawings and maintenance manuals

.10 Mobilization; not to exceed 2% of the contract value

.2 Progress claims will not be certified nor payment made beyond 95% 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.

.3 Change order breakdowns shall include but not be necessarily limited to the following:

.1 Labour hours per unit of material or equipment to be added, deleted or altered

.2 Units of material or equipment to be added or deleted.

.3 Per unit cost of material, equipment and labour broken down by category of labour and type of material or equipment

.4 Extensions of the above to arrive at total costs

.5 Miscellaneous and identifiable charges such as re-stocking, overhead, profit, etc

## 1.21 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to Section 01 01 50.

.2 Refer to detailed specifications in each section for detailed requirements. Provide the following list of required substantial completion submissions.

.1 Final electrical inspector certificate.

.2 Drafted as-built drawings.

.3 Operating and maintenance manual.

.4 Contractors letter of guarantee.

.5 Complete Demonstration of systems to Departmental Representative.

.3 Record drawings to be submitted to the Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

## 1.22 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 by the Contractor. 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 user have been completed.

.6 All documents required have been submitted.

.7 Submit copies of the seismic verification report.

.3 Letters of Assurance will not be issued until the following requirements have been met:

.1 All items listed in 1.22 above have been completed or addressed.

.2 Certificate of penetrations through separations have been sealed and labelled with certified fire stopping material.

.3 Provincial Electrical Inspection - Certificate of inspection.

.4 final inspection report.

.5 Certificate of Substantial Performance.

## 1.23 POWER INTERRUPTIONS

.1 Contractor shall work closely with Departmental Representative to arrange all interruptions of any portion of the existing electrical distribution systems.

.2 All interruptions to existing electrical distribution systems and shutdown of existing Panel boards in the contract shall be carried out outside normal working hours, or on weekends. Normal working hours of the Institution are considered to be 0730 to 1600 hours, Monday through Friday, except holidays.

.3 Contractor shall submit request for any power shutdown 7 working days prior to such power shutdown. Request shall indicate start time of interruption and duration of interruption. Indicate in request exactly what buildings and/or systems will be affected by the requested power shutdown.

.4 No interruptions to power shall be carried out without the approval of the Departmental Representative.Products.

## Part 2 Products

### 2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 01 50.

.2 Do verification requirements in accordance with Section 01 01 50.

### 2.2 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 01 50 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.

### 2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and electrical system related control wiring, conduit, wire, fittings, disconnect switches, 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.

### 2.4 WARNING SIGNS

.1 Provide warning signs, as specified or to meet requirements of Inspection Department and Departmental Representative.

.2 Use decal signs, minimum 175 x 250 mm size.

## 2.5 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

## 2.6 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 Electrical Equipment:

| COMPONENT | LABEL TYPE | INFORMATION |
|---|---|---|
| Main distribution centre | A | Year installed and name of facility |
| | | Name of Electrical Engineer and Electrical Contractor |
| Main Breaker | A | Voltage, phase, amps |
| Sub-distribution panel | A | Name of panels it is feeding (i.e. Panel A, Panel B) |
| Panelboards | B | Panel designation (i.e. Panel A, Panel B) |
| Terminal Cabinet | B | System and Voltage |
| Disconnect switches | B | Indicate equipment controlled and voltage |
| Starters/contactors | B | Indicate equipment controlled and voltage |
| Motor control centre | B | Indicate equipment controlled and voltage |
| Transformer | B | Transformer designation |
| | | Circuit and Panel designation |
| Junction boxes, pull boxes | D | Circuit and panel designation |
| On/Off switches | C | If it is not obvious, then indicate area being served |
| Fire Alarm Devices (i.e. pull stations, bell, smoke detector, end-of –line) | C | Zone number and device number in that zone (i.e. Zone 1-#3, Zone 10-#7) |
| Receptacles | C | Circuit/panel designation |
| Special receptacles | C | Circuit/panel designation and voltage, phase, amps |

.2 Label Type:

| | LETTER HEIGHT | TYPE | COLOUR |
|---|---|---|---|
| Label Type A | 9.5 mm | Lamacoid | White lettering/black background |
| Label Type B | 6.0 mm | Lamacoid | White lettering/black background |
| Label Type C | 3.0 mm | Lamacoid | White lettering/black background |
| | LETTER HEIGHT | TYPE | COLOUR |
| Label Type D | 3.0 mm | Adhesive label | As specified |

.3 Adhesive Labels:

.1 Good quality vinyl, self-laminating label 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.

.4 Provide plastic covered typewritten panel directory with circuits and areas served and mounted on inside of door. Directory shall conform to Record Drawings.

## 2.7 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 C22.1-15 2018.

.4 Use colour coded wires in communication cables, matched throughout system.

## 2.8 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

.1 All junction boxes, pull boxes and their covers shall be painted according to the colour coding schedule.

.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:

| COMPONENT | RACEWAY AND JUNCTION BOXES | RECEPTACLES AND OTHER |
|---|---|---|
| Normal 120/208, 240 volt | Gray | White |
| Normal 347/600 volt | Sand | White |
| Emergency 120/208, 240 volt | Green with red bands | Red |
| Emergency 347/600 volt | Sand with red bands | n/a |
| Fire Alarm | Red | Strobe (red) |
| Low voltage | | |
| -switching/controls | Black | |
| -emergency/exit lighting | Black with red bands | |
| -security | Black with blue bands | Strobe (blue) |
| -mechanical alarms | Black with yellow bands | Strobe (amber) |

**2.9 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.

**2.10 WIRING & CABLES – GENERAL**

.1 Conductors: stranded for 12 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 1000 volt RW90XLPE (X link) for the general building wiring in conduit, unless otherwise specified.

.3 Main feeders to be conduit and insulated copper wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.

.4 Conductors within cable trays shall have ‘plenum’ rated (FT6 type) outer jacket to comply with all applicable regulations and bylaws.

.5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge 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 condulet fittings. Conductors shall not be painted.

## 2.11 FASTENING TO BUILDING STRUCTURE

.1 General:

.1 Do not use inserts in base material with a compressive strength less than 13.79 MPa (2000 psi).

.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.

.2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm (8") pipe size.

.3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm (8") pipe size.

.2 Drilled, mechanical expansion type:

.1 Hilti HSL or UCAN LHL heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa (2840 psi).

.2 Hilti Kwik-Bolt or UCAN WED stud anchor for concrete. (Do not use in seismic restraint applications).

.3 Hilti HDI or UCAN IPA drop-in anchor for concrete.

.4 Hilti or UCAN Sleeve Anchor (medium and light duty) for concrete and masonry.

.5 Hilti ZBP or UCAN Zamac pin bolt (light duty) for concrete and masonry.

.3 Drilled, adhesive type:

.1 Hilti HVA or UCAN Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.

.2 Hilti HY150 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 (2") 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.

.4 One hole steel straps to secure surface conduits 27 mm and smaller. Use two hole steel straps to conduits larger than 27 mm.

## 2.12 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 - Embeco or In-Pakt.

.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.

## 2.13 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.

## 2.14 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into maintenance manual specified in Section 01 01 50 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 trouble shooting instructions.

.4 Local source of supply for each item of equipment.

.5 Wiring and control diagrams.

.6 Spare parts list.

.7 Copies of guarantees and certificates.

.8 Manufacturer's maintenance brochures and shop drawings.

.9 Test and inspection reports.

.4 Submit a draft copy to the Departmental Representative for approval thirty days prior to start up of the systems and equipment.

## 2.15 PROJECT RECORD DRAWINGS

.1 Refer to Section 01 01 50.

.2 During the construction period, maintain on Site a clean set of drawings and specifications marked up clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents and indicating final installation of feeders and branch circuits.

.3 “As-Built” drawing markings shall include but shall not be limited to the following:

.1 All changes in circuiting.

.2 Size and routing of all conduits for all branch circuits including power, lighting and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record “As-Built” drawings the size and routing of all installed raceways and cables.

.3 Number and size of conductors (#10 AWG and larger) in raceways and cables.

.4 Location of all junction boxes and pullboxes.

.5 Location of all conduits or duct stubs, installed equipment, devices and fixtures.

.6 All changes to electrical installation resulting from Addenda, Change Orders and Field Instructions.

.7 Exact location of all services left for future work.

.8 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 2018 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

.3 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.

### 3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturers nameplates and CSA labels are 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 shall be concealed in finished areas.

### 3.4 LOCATION OF OUTLETS

.1 Coordinate outlet locations with Architectural Drawings.

.2 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm and information is given before installation.

.4 Locate disconnect devices in mechanical and elevator machine rooms on latch side of doors.

### 3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation. Confirm the height of devices in handicapped facilities before installation.

.3 Refer to detail on architectural drawings.

.4 In the absence of a drawing detail or drawing note, use the following:

| DEVICE | HEIGHT | | COMMENT |
|---|---|---|---|
| Local switches | 1200 | 48” | |
| Wall receptacles/data | 400 | 12” | General |
| Wall receptacles/data | 175 | 7” | Above top of counters or counter splash backs – coordinate with Architectural detail |
| Wall receptacles/data | 1400 | 56” | In mechanical rooms |
| Panelboards | | | Panelboards: as required by Code or as indicated. |
| Wall mounted telephone | 1500 | 60” | |
| Fire alarm stations | 1200 | 48” | As required by ULC S524. |
| Fire alarm bells/audio/visual | 2300 | 90” | ULC S524 requires not less than 1800mm. In any event not closer than 50mm to the ceiling |
| End of line resistors | 1800 | 72” | |
| Television outlets | | | As receptacles –coordinate with equipment location |
| Wall mounted speakers & clocks | 2100 | 84” | Coordinate with equipment location |
| Door bell pushbuttons | 1200 | 48” | Coordinate with location |
| Emergency Lighting (wall mounted) | | | 150mm below ceiling or<br>2300mm max. |

.5 Confirm mounting height with Departmental Representative prior to rough-in.

## 3.6 DELIVERY AND STORAGE

.1 Store all electrical equipment and devices other than conduits, fittings, boxes, and ducts in a heated and ventilated space, and protect from construction damage. Include in the tender price all costs related to such storage.

.2 Conduits, fittings, boxes, and ducts may be stored outside if properly protected against the weather.

.3 Ship and store floor mounted equipment in upright position.

.4 Ship equipment in adequate containers to assure it arrives undamaged at the site.

.5 Keep equipment doors locked. Protect equipment from damage and dust.

.6 Block moving parts when necessary to prevent damage during movement and shipment of equipment.

.7 Remove from the site, and replace with new, all materials showing evidence of damage or rust.

## 3.7 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Coordinate and pay for all tests specified herein including further tests as required by authorities having jurisdiction.

.2 All testing shall be performed after each system installation has been completed. Prior to commissioning, all motors, MCCs, transformers and switchgear shall be meggered for insulation integrity and the results recorded prior to the systems being put into operation.

.3 Perform the testing, adjusting, and balancing only when conditions are commensurate with actual operating conditions for the given system.

.4 Advise the Departmental Representative 48 hours in advance of each test. Carry out tests in the presence of Departmental Representative.

.5 Submit detailed printed, dated and signed test reports in duplicate to the Departmental Representative within 7 days after the completion of each test. Include all test reports in the Maintenance Manuals. Each test shall clearly indicated, in a line-by-line format, that the components (not as a group) have been tested, test results, and whether test results are within acceptable limits. Each test report shall be accompanied by a front cover sheet briefly outlining what the test report is for and clearly summarizing all items that have failed the tests. The cover sheet shall indicate names of individuals who conducted the tests and their signatures.

## 3.8 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 Conduct and pay for the following tests:

.1 Motors, and associated control equipment including sequenced operation of systems where applicable.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Reports:

.1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

## 3.9 DEMONSTRATION

.1 Demonstrate to and instruct the Departmental Representative on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction and include all costs in the tender. Systems to be demonstrated shall include, but not be limited to, the following:

.1 Routing and installation of major feeders, duct banks and manholes, grounding and cable trays.

.2 Arrange an acceptable time with the Departmental Representative and submit a program of instruction and demonstration for the Departmental Representative's approval. Assume that the Departmental Representative is not familiar with any of the special equipment and/or systems installed.

.3 Submit to the Departmental Representative, at the time of Substantial Performance inspection, a complete list of systems stating for each system:

.1 Date of instruction.

.2 Duration of instruction.

.3 Name of persons instructed.

.4 Other parties present (manufacturer's representative, etc.).

.5 Signature of the Departmental Representative stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

## 3.10 CLEANING

.1 Do final cleaning in accordance with Section 01 01 50.

.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 Section 01 01 50.

## 3.11 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.

### 3.12 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.

### 3.13 PROTECTION 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.

### 3.14 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.

### 3.15 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 Refer to 07 84 00.

.2 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.

.3 The scope 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.

.4 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.

.5 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.

.6 Contractors are expected to submit system information detailing firestopping product, backing, penetration, penetrated assembly, fire and temperature rating, and ULC or cUL system number.

.7 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.

.8 Allow openings for 100% capacity of raceway.

.9 Provide split systems where existing cables are involved.

**3.16 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS**

.1 Provide metal sleeves for 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.

**3.17 EQUIPMENT INSTALLATION**

.1 Provide means of access for servicing equipment.

.2 CSA identification and equipment labels to be clearly visible after installation.

**3.18 COORDINATION**

.1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.

.2 Mechanical equipment and systems specified in Division 21, 22, 23 & 25.

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

**3.19 STARTING MOTORS**

.1 Prior to starting motors:

.1 Perform Megger test on the motors.

.2 Verify phase rotation at motor control centres.

.3 Confirm motor nameplate data with motor starter heater overloads.

**3.20 ENERGIZING EQUIPMENT**

.1 Complete all testing and provide testing result to Departmental Representative prior to energizing equipment.

.2 Confirm equipment nameplate data with characteristics of power supply.

### 3.21 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 correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

.3 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.

.4 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.

.5 Openings in building surfaces other than concrete:

.1 Lay out all openings required.

.6 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.

.7 Precast concrete items such as transformer pad bases and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.

.8 Excavation and backfilling will be provided by other Divisions. This division to supervise the work and provide all layouts and parameters.

### 3.22 PAINTING

.1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and mill scale. 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.

.4 Coordinate with Division 09.

.5 Finish painting of all equipment and materials, supplied under the Electrical Divisions, installed in Electrical Rooms of the building or exposed outside the building, is included under Division 09 of the Specification.

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 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

### 1.3 REFERENCES

.1 CSA C22.1-12 2018

.2 CSA C22.2

.3 National Electrical Manufacturers Association (NEMA)

### 1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

### 1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

### 1.6 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.

.2 Armoured cable (BX) is permitted for lighting fixture drops only; use of BX cable for branch circuits, feeders and home runs is not permitted. Where flexible connections are required, provide wiring in flexible conduits.

.3 Aluminium conductors not permitted.

.4 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 having a PVC jacket with FT-6 flame spread rating.

.5 Provide all control wiring except HVAC controls as specified in Mechanical Divisions. Refer to Equipment Schedule(s) for detailed responsibilities.

.6 Non-metallic sheathed wiring not to be used on this project.

## Part 2 Products

### 2.1 WIRING & CABLES – GENERAL

.1 Conductors: stranded for 12 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 1000 volt RW90XLPE (X link) for the general building wiring in conduit, unless otherwise specified.

.3 Main feeders to be conduit and insulated copper wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.

.4 Conductors within cable trays shall have 'plenum' rated (FT6 type) outer jacket to comply with all applicable regulations and bylaws.

.5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge 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 condulet fittings. Conductors shall not be painted.

### 2.2 TECK CABLE

.1 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: copper, size as indicated.

.2 Insulation: Chemically cross-linked thermosetting polyethylene, type RW90, rated 600 V.

.3 Inner jacket: polyvinyl chloride material.

.4 Armour: interlocking aluminum.

.5 Overall covering: polyvinyl chloride material FT-4/6 flame test rated as specified.

.6 Connectors: Watertight, approved for Teck cable installation.

### 2.3 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).

**2.4 BUILDING WIRE AND CABLE**

.1 Unless otherwise directed, building wire and cable shall be copper conductors, sized as indicated.

.2 Except where otherwise directed or required by Code or other applicable regulations, building wire and cable insulation shall be Type RW90, cross-linked polyethylene insulated 600 volts rated for not less then 90°C.

.3 All conductors within cable trays shall have FT6 type outer jacket to comply with all applicable regulations and bylaws.

.4 Use of NMD90 (Loomex) not permitted.

**2.5 ARMOURED CABLE**

.1 Type: AC 90

.2 Armour: flexible interlocked aluminium

**2.6 WIRE AND BOX CONNECTORS AND MISCELLANEOUS MATERIALS**

.1 Connectors for wire and cable splices and taps: Unless otherwise directed, use 3M Co. 'Scotchlok,' Thomas & Betts PT Series, Buchanan 'B,' IDI Electric 'Super Nut,' or approved equal, for conductors #8 AWG or smaller; Burndy 'Servit' Type KSU or approved equal for conductors #1/0 AWG and smaller; and Burndy 'OKlip' Type KVSU or approved equal for conductors 750 MCM or smaller.

.2 Clamps, glanding connectors, or box connectors for armoured cable, and flexible conduit as required.

.3 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

.4 Plastic electrical insulation tape: Scotch #88 or approved equal.

**Part 3 Execution**

**3.1 INSTALLATION GENERAL**

.1 Unless specifically indicated otherwise, all wiring shall be installed in conduit. Use flexible conduits for final connections to suspend light fixtures and vibrating equipment.

.2 Use no wire smaller than #12 AWG, unless otherwise directed.

.3 Control circuit conductors for motors and mechanical equipment controls shall be not less than #14 AWG except where specifically directed otherwise.

.4 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.

.5 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Canadian Electrical Code. Submit data sheet with values measured.

.6 The number of splices in any circuit shall be kept to an absolute minimum consistent with available coil length and installation conditions.

.7 Conductors for lighting, receptacle, appliance and equipment branch circuits shall have ampacity not less than the rating of the over-current device protecting the branch circuit and shall be sized for a maximum voltage drop of 2% from panelboard to the last outlet of a circuit. The length of the branch circuit to be used in the determination of the required wire size shall be the combined vertical and horizontal distances from the panelboard to the last device in the circuit. In no case shall the wire sizes as determined above, be less than that indicated in the following table.

120 Volts, 1 Phase

| 15 Ampere Circuits | 20 Ampere Circuits |
|---|---|
| 0-25 m - min. #12 AWG | 0-20 m - min. #12 AWG |
| Over 25 m - min. #10 AWG | 0 m-30 m - min. #10 AWG |
| | Over 30 m - min. #8 AWG |

347 Volts, 1 Phase

| 15 Ampere Circuits | 20 Ampere Circuits |
|---|---|
| 0-75 m - min. #12 AWG | 0-55 m - min. #12 AWG |
| Over 75 m - min. #10 AWG | Over 55 m - min. #10 AWG |

.8 Make final connections to recessed incandescent or gas-discharge lamp fixtures, and other heat-producing equipment with thermoplastic insulated, lacquered glass-braid-jacketed "equipment wire," except that where higher temperature rating of insulation or larger conductor size than #10 AWG is required, use wire specifically approved for the purpose.

.9 Exercise care in stripping insulation from wire. Do not nick conductors; if nicked replace with new.

## 3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34.

## 3.3 INSTALLATION OF ARMOURED CABLE

.1 Unless specifically directed to the contrary, use armoured cables only for:

.1 Final connections from a junction box above accessible suspended ceilings to recessed light fixtures to a maximum length of 1500mm.

.2 Final connections from a junction box above accessible suspended ceilings down stud and drywall partitions to receptacles. Ceiling junction box to be located as close as possible to the partition wall and not further away than 900 mm.

.2 Armoured cables are not permitted to run around corners. Interconnection of electrical devices on adjacent walls shall be done via the ceiling space.

.3 Armoured cables in accessible ceiling spaces shall not be dragged on ceiling tiles but shall be fastened to the underside of the structure using manufacturer's approved fastening devices. Armoured cables shall not run draped below pipes and ducts but shall be fished over such obstructions

.4 Do not attach cables to the ceiling suspension system or to mechanical ductwork or piping.

## 3.4 IDENTIFICATION, CODING AND BALANCING

.1 For branch circuit wiring, follow identification system shown on the drawings and as specified in Section 26 05 00 – Common Work.

.2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on the records drawings.

.3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.

.4 Conductors sized No. 10 and smaller are required to be factory coloured, not taped on site.

## 3.5 TESTING

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by the cable manufacturer.

.2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Departmental Representative.

END OF SECTION

## Part 1 General

### 1.1 RELATED WORK

.1 Section 26 05 00 – Common Work.

### 1.2 REGULATORY REQUIREMENTS

.1 Restraints shall meet the requirements of the latest edition of the National Building Code and amendments.

.2 The Seismic Engineer shall be a registered BC Professional Engineer in good standing and should be able to provide a proof of professional insurance and the related practice credentials if requested by the Departmental Representative.

.3 The Contractor's Seismic Engineer shall submit original signed National Building Code "Letters of Assurance" "Schedules B1, B2, and C-B" to the Departmental Representative.

.4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

### 1.3 SCOPE

.1 The total electrical seismic restraint design, field review and inspection will be by a structural engineer who specializes in the restraint of building elements and is registered with the local engineering association. Contractor shall allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer herein referred to as the Seismic Engineer, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

.2 It is the 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.

.3 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Section 01 01 50.

.4 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

.5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.

.6 The Seismic Engineer shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.

.7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

.8 The Seismic Engineer shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

.9 Include all costs associated with the seismic installation and certification in the base tender.

**1.4 SHOP DRAWINGS & SUBMITTALS**

.1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic Engineer.

.2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Engineer.

## Part 2 Execution

**2.1 GENERAL**

.1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

.2 Ensure that seismic restraints do not adversely affect the proper functioning of any vibration isolation mounts or hangers.

**2.2 CONDUITS**

.1 Provide restraint installation information and details on conduit and equipment as indicated below:

.2 Vertical Conduit:

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

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

.3 Riser joints shall be braced or stabilized between floors.

.3 Horizontal Conduits:

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

.2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing.

.4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.

.5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.

.6 Do not brace conduit runs against each other. Use separate support and restraint system.

.7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.

.8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

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

.10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic Engineer and submit shop drawings to the Departmental Representative for his reference.

## 2.3 FLOOR MOUNTED EQUIPMENT

.1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.

.2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

## 2.4 LIGHT FIXTURES

.1 Fluorescent fixtures in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two taught cables which are connected to the fixture at diagonal points.

.2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.

.3 Fixtures which are hung independently of ceiling systems shall have minimum of one seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.

.4 Cables shall be corrosion resistant and approved for the application.

.5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.2 CSA C22.1-12 2018

.3 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.4 Transformer grounding shall comply with CSA C22.2 No.41-M87 (R99).

.5 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

### 1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

## Part 2 Products

### 2.1 MATERIALS

.1 Grounding equipment to: CSA C22.2 No.41-M87 (R99).

### 2.2 EQUIPMENT

.1 Clamps for grounding of conductor, size as required.

.2 Copper conductor at least 6m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated. If not indicated, use 3/0AWG which is the maximum in Table 43 CEC.

.3 Rod electrodes, copper clad steel 20mm dia by 3m long as indicated.

.4 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified to be green.

.5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.6 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

## Part 3 Execution

### 3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

.2 Provide separate, insulated, copper bonding conductor in EVERY conduit used for power, lighting, fire alarm and every low tension system required in the building. Where wire size is not indicates, provide minimum size per applicable CEC tables.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors approved for the use.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 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.

.9 Install separate ground conductor to each outdoor lighting standard.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

.13 Ground secondary service pedestals in raised computer floors.

.14 Coordinate ground rod installation with local soil conditions to assure proper grounding system.

## 3.2 GROUNDING ELECTRODES

.1 Provide and install an artificial ground consisting typically of a minimum of four 3000mm x 20mm copperweld ground rods, interconnected by bare stranded copper #1 AWG conductors and terminating to the Main Electrical Room ground bus. Conductors shall be connected to the ground rods with compression type fittings and shall be buried 600 mm below grade. Check and measure the installation to ensure an adequate resistance to ground before covering.

.2 Provide ground test well over one of the rods on the ground grid to allow access to the grid for testing.

## 3.3 BUILDING SERVICES GROUNDING

.1 WATER - From the main electrical room ground bus, connect #3 AWG insulated ground conductor in 27mm conduit to water main with approved ground clamp ahead of water meter. Install 1#3/0 ground conductor jumper strapped around water meter and associated unions and valves to ground building side of water system.

.2 METALLIC WASTE WATER PIPING - Each metallic waste water piping system to the building to be grounded by bonding it to the interior metallic water supply system by copper bonding jumper of not less than #3 AWG

.3 GAS PIPE GROUNDING - 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.

## 3.4 GROUNDING BUS

.1 Provide ground bus in the main electrical room and main communication room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #3 AWG or as indicated.

.3 Copper or bronze lugs required for termination of all copper conductors at ground busses.

## 3.5 EQUIPMENT GROUNDING AND BONDING

.1 Install bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, starters, UPS, control panels, building steel work, raised floor systems, generators, distribution panels and outdoor lighting.

.2 Provide grounding conductor(s) from all major switchgear to solidly ground the secondary system. This includes equipment located in the main electrical room as well as each sub-electrical room. Grounding conductors to be sized to Canadian Electrical Code and switchgear manufacturer's requirements.

## 3.6 MECHANICAL EQUIPMENT BONDING

.1 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.

## 3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions.

.3 Measure ground grid resistance with earth test megohmmeter and install additional ground rods and conductors as required until resistance to ground complies with Code requirements and is less than 5Ω. Submit test results to Department Representative.

.4 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.

.5 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

## Part 1 General

### 1.1 WORK INCLUDED

.1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

### 1.2 RELATED WORK

.1 Section 26 05 00 – Common Work:

.2 Section 26 05 25 - Seismic Restraints:

## Part 2 Product

### 2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.2 Finishes:

.1 Outdoors, wet locations: Hot dipped galvanized.

.2 Indoors, dry locations: Galvanized when available, prime painted if not available.

.3 Nuts, bolts, machine screws: Cadmium plated.

.3 Unistrut:

.1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

### 2.2 CONCRETE AND MASONRY ANCHORS

.1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

### 2.3 NON-METALLIC ANCHORS

.1 Material: Plastic anchors for sheet metal screws.

**2.4 CONDUIT SUPPORTS**

.1 General: Malleable iron two-hole conduit straps where exposed to weather. Stamped steel two-hole straps indoors.

.2 Structural Steel: Bolt on clamp type supports.

.3 Masonry, concrete, stone, etc.: Anchors.

.4 Title: Toggle bolts.

.5 Metal studs, ceiling hangers, etc.: Push-on, snap in type supports

.6 Unistrut: Unistrut conduit clamps.

**2.5 CABLE SUPPORTS AND CLAMPS**

.1 General: As per conduit supports, except that for single conductor cables, suitable non-ferrous or approved stainless steel or aluminum clamps shall be used.

**Part 3 Execution**

**3.1 GENERAL**

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Engineer is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer’s installation recommendations.

.6 Provide conduit rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

**3.2 INSTALLATION**

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.6 Shot driven pins may only be used with written approval of the structural engineer.

.7 Use round or pan head screws for fastening straps, boxes, etc.

.8 Do not support heavy loads from the bottom chord of open web steel joists.

.9 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.

.10 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.

END OF SECTION

## Part 1 General

### 1.1 WORK INCLUDED

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

### 1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

.3 Section 26 05 25 – Seismic Restraints

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 01 50.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

## Part 2 Products

### 2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

### 2.2 JUNCTION BOXES AND PULL BOXES, INDOOR DRY LOCATIONS

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatised and/or galvanized.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

.3 Size shall be in accordance with Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes.

.4 Surface or flush with trim and hinged door, latch and lock and two keys and keyed to match panelboard keys.

.5 Backboards: 19 mm GIS Fir plywood backboard.

.3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

**2.3 CABINETS**

.1 Materials:

.1 Cabinets: Code gauge sheet steel, welded construction, phosphatised and factory paint finish, suitable for field painting.

.2 Locks: to match panelboards.

.3 Backboards: 19 mm GIS fir plywood, one piece per cabinet, covering entire cabinet interior.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Surface or flush with trim and hinged door, latch and lock and two keys, size as indicated or to Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes. Keyed to match panelboard keys.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.2 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.

.2 Install terminal block where indicated.

.3 Identification

.1 Provide equipment identification in accordance with drawings.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

### 1.2 REFERENCES

.1 CSA C22.1-12 2018 - Canadian Electrical Codes, Part 1.

### 1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

## Part 2 Products

### 2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1-12 2018.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

### 2.2 OUTLET BOXES FOR METAL CONDUIT

.1 Materials:

.1 Surface or recessed concealed type: Die formed steel, hot dip galvanized, 350 g/m² minimum zinc coating.

.2 Surface mounting exposed: Cast ferrous for threaded conduit, with attached lugs, corrosion resistant two coats finish.

**2.3 JUNCTION & PULL BOXES**

.1 Electro-galvanized sheet steel type boxes for flush mount in walls with matching extension and plaster rings as required.

.2 Install pull boxes in inconspicuous but accessible locations.

.3 Install pull boxes after cumulative bend total of 270 degrees between boxes.

.4 Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

**2.4 CONDUIT BOXES**

.1 Cast FS or electro-galvanized sheet steel boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

**2.5 FITTINGS - GENERAL**

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, and armoured cable connections. Reducing washers are not allowed.

.5 Install all outlets flush and surface mounted as required for the installation.

.6 Surface mount above suspended ceilings, or in unfinished areas.

.7 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.9 Use plaster rings to correct depth. Use 30 mm on concrete block.

.10 Do not use sectional boxes.

.11 Provide boxes sized as required by the Canadian Electrical Code.

.12 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.13 Outlets installed in partition walls to be offset by a minimum of one stud space.

.14 Ceiling outlet boxes shall be provided for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.

.15 Primary bushings in termination box for cable connection.

.16 Secondary bushings in termination box for bus duct connection.

.17 For telecom conduit runs:

- .1 Achieve the best route with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
- .2 Contain no continuous section longer than 30.5 meter (100 feet).
- .3 Be bonded to ground on one or both ends in accordance with national or local requirements.
- .4 Withstand the environment to which they will be exposed.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

.3 Section 26 05 25 – Seismic Restraints

### 1.2 REFERENCES

.1 CSA C22.1-12 2018.

.2 Canadian Standards Association (CSA).CAN/CSA C22.2.

### 1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

### 1.5 SCOPE OF WORK

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Conceal all conduits in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.

.3 Note particular requirements for routing of conduits where detailed.

.4 Provide polypropylene pull cord in all “empty” conduits.

.5 Conduits and boxes penetrating rated fire walls, ceilings and floors shall be properly firestopped and sealed for fire and smoke travel.

## Part 2 Products

### 2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.

.2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

.3 Flexible conduits: to CSA C22.2 No. 56.

.4 Minimum conduit size in the project to be 21mm (3/4’) diameter (for power as well as low tension services).

## 2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 27 mm and smaller. Use two hole steel straps to conduits larger than 27 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 10 mm 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 35 mm and larger conduits.

.3 EMT couplings and connectors 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 19 mm 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" Schedule 40.

.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 Combination boxes with barriers where outlets for more than one system are grouped.

.6 Bushing and connectors with nylon insulated throats.

.7 Knock-out fillers to prevent entry of foreign materials.

.8 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.

.9 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 54 mm 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.

.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 MASONRY BOXES**

.1 Electro-galvanized steel masonry single and multi gang type MDB boxes for devices flush mounted in exposed block walls.

**2.9 CONCRETE BOXES**

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

**2.10 SURFACE CONDUIT BOXES**

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

**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 all conduit and wiring concealed, unless otherwise shown on the drawings. Do not recess conduit in columns, except as noted, without permission.

.3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.

.4 At all recessed panels cap 4 - 27 mm empty conduits from panel into ceiling above for future use.

.5 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.

.6 Any conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.

.7 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

.8 Ensure grounding continuity in all conduit systems.

.9 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 1.5 m (5') above the finished floor.

.10 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

.11 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.

.12 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.

.13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: e.g. where conduits emerge from ground level slab.

.14 Conduits are not permitted in terrazo or concrete toppings.

.15 Cap turned up conduits to prevent the entrance of dirt of moisture during construction.

.16 Locate conduits more than 75 mm parallel to steam or hot water lines with a minimum of 25 mm 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 shown on the drawings 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.

.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 flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.

.32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

.33 Use explosion proof flexible connection for connection to explosion proof motors.

.34 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

## 3.2 SURFACE CONDUITS

.1 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

.2 Run parallel or perpendicular to building lines.

.3 Locate conduits behind infrared or gas fired heaters with minimum 1.5 m clearance.

.4 Conduits to be run in flanged portion of structural steel.

.5 Group conduits wherever possible on suspended and/or surface channels.

.6 Surface conduits will not be accepted in finished areas unless detailed.

**3.3 SPARE CONDUITS**

.1 Provide spare conduits as indicated.

.2 Provide 4x27 mm spare conduits up to ceiling space and 4x27 mm spare conduits down to ceiling space below from each flush panel. Terminate the conduits in 150x150x100 mm junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide coverplates for all junction boxes.

**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 1.0 General

### 1.1 DOCUMENTS

.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 REQUIREMENTS

.1 Supply and install branch circuit panelboards as indicated on the drawings and as hereinafter specified.

.2 Shop drawings of all panelboards shall be reviewed by the departmental representative before construction commences.

## Part 2.0 Materials

### 2.1 MATERIALS

.1 Panelboards shall be of the molded case circuit breaker type, for surface or flush mounting. Panelboard boxes shall be fabricated from #12 code gauge steel, either satin galvanized finish or painted with rust resistant primer paint and two coats of glossy acrylic enamel. Trims shall be fabricated from code gauge sheet steel painted with rust resisting zinc-chromate primer paint and two coats of glossy acrylic enamel, ASA61E. Panelboards in public spaces to be custom painted to match the walls.

.2 Breakers shall be of the bolted quick-lag type sized as indicated, quick-make, quick-break, thermal magnetic action. Multi-pole breakers shall have a common trip with a single operating handle. Minimum short circuit rating shall be 10,000 amperes rms symmetrical. Panels shall be rated minimum 225A. Double tub panels shall be factory assembled and certified for the application.

.3 Trims shall have doors equipped with flush hinges and double lock. A lock and catch shall be at the top and bottom of the doors. Two keys shall be supplied with each lock. All locks shall be common keyed. Panelboard catches shall be flush with the trim cover. Trims shall be of sufficient gauge to prevent warping. 42-circuit and larger panelboards shall have two locks. Minimum size: 146mm deep 508mm wide.

.4 Breakers shall be identified on a typewritten directory blank form supplied by manufacturer mounted in a suitable frame facing inside each panel door, indicating the circuit being controlled by each breaker. Wording for the directory shall clearly identify the load or area being controlled, and the breaker size, such as the following:

.1 Lights – Amenity Room 121 – 15A

.2 Receptacles – Office 125 -15A

.3 Exhaust fan – Electrical Room 225 – 15A 3P

Provide a copy of the directory in the Maintenance Manual.

.5 Spare breakers shall be identified as “SPARE” on the typewritten directory.

.6 Panels shall have numbered circuits: odd numbers on left and even numbers on the right.

.7 Surface mounted panels shall be sprinklerproof. All conduits penetrating sprinklerproof panels shall be sealed using rain tight connectors, NEMA 2 rated complete with top drip shield.

.8 Panelboard busbar material shall be copper tin plated.

.9 Shop drawings to include an elevation drawing and trim lower detail.

.10 Acceptable manufacturers: Match with existing the manufacturer shall be the same as the manufacturer of the distribution.

## Part 3.0 Execution

### 3.1 GENERAL

.1 Breakers shall be identified on a typewritten directory mounted in a suitable frame facing inside each panel door, indicating the circuit being controlled by each breaker. Wording for the directory shall clearly identify the load or area being controlled, such as: "Lights – Level 3-Corridor, North.

.2 Provide "lock-dog" devices on all breakers serving signs, emergency lighting, exit lights, alarm systems, night lights, telephone and data distribution equipment.

.3 Panelboards shall be mounted with tops of panelboard at +1800 mm above the finished floor. Coordinate panelboard heights and locations with Architectural trims, etc.

.4 The contractor shall, if so directed, replace circuit breakers from the size specified to other ampere size ratings within the same frame size without extra cost to the contract up to the date of substantial completion.

.5 All panel locks shall be common-keyed.

.6 Each panelboard shall be complete with door, catch, and two keys. Double door locks.

.7 Panelboard voltage and bus capacity shall be shown on the panel schedule.

.8 CSA approved panels must be provided. All panelboards must be bolt-on molded case circuit breaker type, with copper mains, rated for the available interrupting capacity.

.9 All two and three pole breakers must have common trip type with single handle.

.10 Panelboards shall be mounted with tips of panelboard at +1800 mm above the finished floor.

.11 At each panelboard, install two empty 27 mm conduits into accessible crawlspace. Spare conduit to be clearly identified. Conduits to be terminated in 300 X 300 mm junction box.

.12 A minimum of 20% spare capacity must be provided for all panelboards.

.13 When multi-section panelboards are installed, panelboard sections shall not be used as wireway for wiring from other section.

## 3.2 SPARE CIRCUIT BREAKERS

.1 Provide five (5) 15A 1-pole spare loose circuit breakers to the Department Representative in addition to any breakers indicated on the panelboard directory or throughout the drawings.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

### 1.2 REFERENCES

.1 CSA C22.1-12 2018

### 1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

## Part 2 Products

### 2.1 SWITCHES

.1 Extra heavy duty specification grade.

.2 20 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.

.3 Manually-operated general purpose ac switches as indicated and with following features:

.1 Terminal holes approved for No.10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 White toggle (red toggle for emergency power circuits).

.4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rating capacity of motor loads.

.5 Switches of one manufacturer throughout project.

.6 Acceptable products or approved equal:

.1 Arrow Hart 1900 series

.2 Bryant 4900 series

.3 Hubbell HBL.1221 series

.4 Leviton 1221-2 series

.5 Pass & Seymour PS20AC1 120V series

**2.2 RECEPTACLES – GENERAL**

.1 Extra heavy duty specification grade.

.2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:

.1 White nylon molded housing (red for emergency power circuits, blue for surge protection)

.2 Suitable for No.10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and non riveted grounding contacts.

.3 Duplex receptacles with a CSA Configuration of 5-15R and 5-20R installed within the Living Unit shall be tamper-resistant. Receptacles dedicated for microwaves, refrigerators, freezers or kitchen counters are excluded.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable products or approved equal:

.1 Arrow Hart 6262

.2 Bryant 5262.

.3 Hubbell 5262 series

.4 Leviton 5262 series

.5 Pass & Seymour 5262 series

**2.3 RECEPTACLES – 20A**

.1 Extra heavy duty specification grade.

.2 Duplex receptacles, CSA type 5-20 RA, 125 V, 15/20 A, U ground, with following features:

.1 White nylon molded housing (red for emergency power circuits)

.2 Suitable for No.10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and non riveted grounding contacts.

**2.4 COVER PLATES**

.1 Stainless steel: Type 302 or 304, No. 4 finish, 1mm thick, accurately die cut, protective cover for shipping. For general interior flush mounted wiring devices and surface type FS or FD type boxes.

.2 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.

.3 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.

.4 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.

.5 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Coverplates to fasten to box by four screws.

.7 Gaskets: resilient rubber or close cell foam urethane. All gaskets inside inmate cells shall be air tight type to maintain negative air pressure in the cells.

.8 Cover plates for all wiring devices to be from one manufacturer throughout project.

**Part 3 Execution**

**3.1 INSTALLATION GENERAL**

.1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.

.2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.

.3 All plates to be installed parallel or perpendicular to building lines.

**3.2 INSTALLATION PARTICULAR**

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.2 Receptacles:

.1 Install all receptacles in the vertical plane unless otherwise noted.

.2 Generally install the 5-15/20R U ground pin down unless otherwise noted.

.3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.4 Where split receptacles has one portion switched, mount vertically and switch the upper portion.

.5 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Use weatherproof cover plates in wet locations and where indicated.

.5 Provide a label on every switch and receptacle cover plate indicating panel and circuit number.

END OF SECTION

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

### 1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

.2 Include time-current characteristic curves for breakers with ampacity of 100A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

## Part 2 Products

### 2.1 BREAKERS - GENERAL

.1 Moulded-case circuit breakers, and ground-fault circuit-interrupters, and accessory high-fault protectors: to CSA C22.2 No. 5.

.2 Breakers shall be of the same manufacturer and have the same interrupting capacity of panel or panelboard into which it is being installed.

.3 Bolt-on moulded-case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.4 Plug-in moulded-case circuit breakers shall not be used.

.5 Common-trip breakers: with single handle for multi-pole applications.

.6 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.

.7 Circuit breakers with interchangeable trips as indicated.

## 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.

END OF SECTION

## Part 1 General

### 1.1 RELATED WORK

.1 Mechanical: Divisions 23 and 25

### 1.2 REQUIREMENTS

.1 Provide a complete system of wiring to motors and mechanical controls as specified herein and as shown on the drawings.

.2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under contracts related to this project or relocated as part of the scope. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other divisions.

.3 Unless specifically noted otherwise, supply all disconnects, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

.4 Do not operate motors and controls until approval is obtained from the trade providing equipment.

.5 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades' drawings and shop drawings.

.6 Assist in placing in operation all mechanical equipment having electrical connections.

.7 Provide three phase starters with fused 120 volt control transformers and overload relays.

.8 Provide all power wiring for all motors.

.9 Provide power wiring for heating ventilating and air conditioning equipment. Provide terminations in starters and MCCs for control wiring so that starter control circuits may be extended. Where 120 volt power is required for mechanical equipment, i.e. roll type filters, refrigerated aftercoolers, control cabinets, etc. wiring to the equipment terminals is the work of this Division.

.10 Refer to Mechanical Equipment Schedule attached.

.11 The motor control work which shall be provided under Division 26 shall include the following:

- .1 All conduit and control wiring specifically noted on the drawings and outlined in the different parts of the Specification.
- .2 Conduit and control wiring for baseboard heaters, unit heater and force flow heater thermostats.
- .3 All control wiring as specified in the Motor Schedule.
- .4 Control wiring related to air handling shutdown during fire alarm.

## Part 2 Products

### 2.1 3 PHASE MOTOR DISCONNECT SWITCHES

.1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use NEMA 4X enclosures outdoors, and NEMA 1 indoors, switches to be H.P. rated, heavy duty type.

### 2.2 120 VOLT, 1 PHASE DISCONNECT SWITCHES

.1 Manual disconnect switch HP rated (starter) without overload relay.

### 2.3 208 VOLT, 1 PHASE MOTOR DISCONNECT SWITCHES

.1 Manual disconnect switch HP rated (starter) without overload relay – two pole.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Provide disconnect switches adjacent to all motors.

.2 Install wiring between all mechanical components to provide a functional system.

.3 Do control wiring as indicated on the drawings and the motor control schedules.

END OF SECTION

## Part 1 General

### 1.1 RELATED WORK

.1 Common Work Requirements: Section 26 05 00

.2 Section 26 98 00 - Testing, Adjusting and Balancing of Electrical Equipment

### 1.2 COORDINATION

.1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.

.2 Mechanical equipment and systems specified in Division 21, 22, 23 & 25.

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

## Part 2 Products (not used)

## Part 3 Execution

### 3.1 STARTING MOTORS

.1 Prior to starting motors:

.1 Perform Megger test on the motors.

.2 Verify phase rotation at motor control centres.

.3 Confirm motor nameplate data with motor starter heater overloads.

### 3.2 ENERGIZING EQUIPMENT

.1 Complete all testing and provide testing result to Departmental Representative prior to energizing equipment.

.2 Confirm equipment nameplate data with characteristics of power supply.

END OF SECTION

## Part 1 General

### 1.1 INTENT

.1 Except where otherwise specified, arrange testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the Departmental Representative, who shall also sign the test documentation.

### 1.2 RELATED WORK

.1 Section 26 05 00: Common Work

.2 Section 26 96 00: Starting of Electrical Equipment and Systems

### 1.3 MANUFACTURER'S PRODUCTION TEST RECORDS

.1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

### 1.4 SITE TESTING REPORTS

.1 Log and tabulate test results on appropriate test report forms. Submit forms to Departmental Representative for approval prior to use.

.2 Submit completed test report forms as specified, immediately after tests are performed.

### 1.5 REFERENCE DOCUMENTS

.1 Perform tests in accordance with:

.1 The Contract Documents

.2 Requirements of authorities having jurisdiction

.3 Manufacturer's published instructions

.4 Applicable CSA, IEEE, IPCEA, EEMAC and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Departmental Representative before proceeding with test and obtain clarification.

### 1.6 SEQUENCING AND SCHEDULING

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

## Part 2 Products

### 2.1 TEST EQUIPMENT

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

## Part 3 Execution

### 3.1 TESTING OF WIRING AND WIRING DEVICES

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

### 3.2 LOAD BALANCE TESTING

.1 Perform load tests when as many loads as possible, prior to Interim Acceptance of the Work, are operable.

.2 Turn on all possible loads.

.3 Test load balance on all feeders at distribution centres, motor control centre and panelboards.

.4 If load imbalance exceeds 15%, reconnect circuits to balance loads.

### 3.3 VOLTAGE TESTING AND ADJUSTING

.1 Test voltage at all panelboards.

.2 Test voltage at motor starters.

.3 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by Departmental Representative.

END OF SECTION

## Part 1 General

### 1.1 SUMMARY

.1 Section includes:

.1 Chain link fence & gate

### 1.2 RELATED REQUIREMENTS

.1 Structural - Cast-in-Place Concrete

### 1.3 COORDINATION

.1 Coordinate with Section 08 71 00 for exit device mounting plate. Obtain templates prior to fabrication.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

### 1.5 SUBMITTALS

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

.2 Shop Drawings: Site plan showing layout of fence location with dimensions, location of gates and opening size, cleared area, elevation of fence, gates, footings and details of attachments.

.3 Material samples: provide representative samples of chain link fabric, framework and fittings.

## Part 2 Products

### 2.1 MATERIALS

.1 Chain-link fence fabric: to CAN/CGSB-138.1.

.1 Exterior: Type 1, Class A, Style 1, Grade 2.

.1 Height of fabric: 2 400 mm

.2 Posts, braces and rails: to CAN/CGSB-138.2, Type 1, except provide minimum 89 mm diameter terminal posts and larger as required by CAN/CGSB-138.4.

.3 Bottom tension wire: to CAN/CGSB-138.2, single strand, galvanized steel core wire.

.4 Tie wire fasteners: galvanized steel core wire.

.5 Tension wire: to CAN/CGSB-138.2, single strand, galvanized steel within 300mm of the top and bottom of the fence fabric.

.6 Gates: to CAN/CGSB-138.4, styles 1 (Single Swing), and 2 (Special Sliding) as shown.

.7 Gate frames:

.1 General:

.1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.

.2 Fasten fence fabric to gate with knuckled selvage at top.

.2 Gate style 1: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing.

.1 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for exit device attached and operated from inside of installed gate.

.2 Furnish gate with chain hook to hold gates open.

.3 Provide exit device mounting plate on interior side of gate frames where indicated.

.1 Profile: 450 mm high C channel, with 125 mm horizontal returns and 25 mm vertical face. Full width of gate frame

.1 Provide weep holes at 150 mm on centre in bottom of channel.

.2 Framing:

.1 Provide horizontal rail framing at top and bottom of mounting plate to accommodate mounting of plate.

.2 Provide vertical post between horizontal rails to frame opening for exterior side hardware.

.3 Tack weld plate to framing at 150 mm on centre.

.4 Provide bent plate at strike to accept mounting of exit device hardware. Weld plate to gate post.

.3 Gate Style 2: to ASTM A53/A53M, galvanized steel pipe, standard weight pipe for perimeter frame and interior bracing. Pipe diameter designed by fence provider.

.1 Provide counter balance frame with gate posts and rollers to suit opening dimensions indicated on drawings, and to support cantilever linear sliding operation.

.1 Provide posts; top, bottom, and intermediate rails; and diagonal bracing.

.8 Fittings and hardware: to CAN/CGSB-138.2, galvanized steel.

.1 Tension bar bands: 5 x 20 mm minimum. .

.2 Post caps to provide waterproof fit, to fasten securely over posts.

.3 Exterior overhang tops to provide waterproof fit, with both outward and inward projection to hold barbed wire overhang.

.4 Turnbuckles to be drop forged.

.5 Surface mounted floor flanges: Malleable steel base sleeve to secure posts to interior concrete slab.

.6 Exit Device Mounting Plate: to ASTM A653/A653M, 1.35 mm minimum base steel thickness, galvanized Z275 coating designation. Galvanize after fabrication.

.7 Exit device: To Section 08 06 71 – Door Hardware

.9 Barbed wire: to CAN/CGSB-138.2, zinc coated steel wire, three strands spaced 150 on centre.

.10 Cast-in-place concrete: To Section 03 30 00.

**2.2 FINISHES**

.1 Galvanizing: Galvanize interior and exterior fence components as follows:

.1 Chain link fabric: to CAN/CGSB-138.1:

.1 Exterior: Grade 2.

.2 Pipe: 550 g/m$^2$minimum to ASTM A90.

.3 Fittings and Hardware: 550 g/m$^2$minimum to CAN/CSA-G164.

.4 Barbed Wire: to CAN/CGSB-138.2.

**Part 3 Execution**

**3.1 GRADING**

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.

**3.2 ERECTION OF FENCE**

.1 Erect fence along lines as indicated and to CAN/CGSB-138.3.

.1 Ensure 450 mm minimum setback between fence and property line.

.2 Exterior Post footings: Construct post footings to dimensions indicated:

.1 Line posts: 1524 mm depth x 450 mm diameter.

.2 Terminal posts: 1824 mm depth x 450 mm diameter.

.3 Interior Post Anchoring: Fasten surface mounted floor flanges to concrete floor maintaining minimum clearance dimensions to edge of floor using manufacturer's recommended anchors.

.4 Space line posts 3 m apart, measured parallel to ground surface.

.5 Locate chain link fabric on outside of fence posts.

.6 Install terminal posts in accordance with CGSB 138.3 and located as follows:

.1 End of fence

.2 Buildings.

.3 Corners including changes of direction greater than 10 degrees.

.4 Sides of gate openings.

.7 Place concrete in post holes, embed posts into concrete in accordance with CGSB 138.3.

.1 Extend concrete 50 mm above ground level and slope to drain away from posts.

.2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.8 Do not install fence fabric until concrete has cured minimum of 5 days.

.9 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.

.1 Install braces on both sides of corner and straining posts in similar manner.

.10 Install overhang tops and caps.

.1 Install barbed wire strands and clip securely to lugs of each projection. 3 Layers.

.11 Install bottom and top tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.12 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.

.1 Exterior: Knuckled selvedge at top and bottom.

.2 Interior: Knuckled selvedge at top and bottom

.13 Set bottom of fence fabric 610 mm below finished grade.

.14 Secure fabric to posts with tie wires at 380 mm intervals, and to tension wire at 610 mm intervals.

.1 Give tie wires minimum two twists.

## 3.3 INSTALLATION OF GATES

.1 Install gates in locations as indicated.

.2 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface except 150 mm clearance at gate style 4.

.3 Determine position of centre gate.

.1 Cast gate rest in concrete as indicated for terminal posts.

.4 Install gate stops where indicated.

## 3.4 CLEANING

.1 Dispose of fill materials from post hole construction as directed by Consultant.

.2 Clean and trim areas disturbed by operations.

.3 Dispose of surplus material as directed by Consultant.

END OF SECTION

# APPENDIX A
# HAZARDOUS BUILDING MATERIALS ASSESSMENT

# Appendix 5.19 FINDINGS AND RECOMMENDATIONS—BUILDING M2A—ADMINISTRATIVE OFFICES (831-07-RP)

Building M2A—Administrative Offices (subject building) was reportedly constructed in 1965 and has been assigned Real Property ID #1534. The typical structural components and finishes associated with this one-story building consist of exterior brick and cast concrete walls; interior plaster and drywall walls; plaster, drywall and tile ceilings; ceramic, vinyl tile and sheet flooring; and a flat asphalt membrane roof. It should be noted that the building is adjoined to building M2B - visiting & correspondence and may share some mechanical systems.

The results of the assessment for each of the considered hazardous materials within the subject building are provided in the following sub-sections.

The following areas were not accessed, for the reasons indicated:

- Pipe chase accessible from north hallway (hatch was painted shut)
- Ceiling space areas other than those in the immediate vicinity of an access point. Although the ceiling space was accessed at several access points, for safety reasons (clearance within the space limited our ability to move about safely), Stantec did not enter the ceiling space to assess conditions throughout.

As such, limited comments, if any, will be provided regarding the presence, quantity or condition of hazardous building materials within the above-noted areas.

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.

## 5.19-1 ASBESTOS

The Previous Reports indicated the presence of the following ACMs, with notes regarding condition or other changes noted during the current assessment:

- Pipe insulation in rooms 127, 119 and 115 (PGL, ACM Survey Report 2004)
  - Not observed to be present by Stantec during the current assessment. It should be noted that both samples labelled pipe insulation that were collected in the PGL report indicted no asbestos detected. This material may have been identified based on lab results from other buildings at Matsqui Institution.
  - Stantec observed what appeared to be cementitious insulation within the ceiling plenum but could not safely access it in order to collect samples. As such, pipe insulation in the ceiling plenum should be presumed to be ACM until proven otherwise through further sampling/analysis.

- Air duct joint mastic in rooms 127, 119 and 115 (PGL, ACM Survey Report 2004)
  - Samples were collected for three different colours of mastic during the current assessment and both the gold and white mastics were confirmed to be ACM
- Trace chrysotile asbestos was detected in a sample of adhesive with debris associated with floor tile in corridor 137 (PGL, ACM Survey Report 2004)
  - Floor tile in corridor 137 was sampled during the current assessment and no asbestos was detected
- 9”x9” size vinyl floor tiles, both white and tan colour, within room 136a (now part of room 136) (Stantec M2A and IT Area Report 2010)
  - This material was reportedly partially removed in 2011 in room 136a (Stantec M2A and IT Area Abatement Report 2011)
  - ACM floor tile was identified remaining present in room 136 (136a now merged with 136) beneath raised flooring based on samples collected during the current assessment
- Thermal insulation wrap applied to storm drain pipe in room 104 (Arcadis M2A SIO Report 2016)
  - Presumed to refer to tar paper jacketing
  - Observed to have been removed in the location indicated above, but observed to remain in other locations throughout
- Vinyl floor tiles and underlying mastic (aqua 12”x12”) in room 115 janitor’s closet (Arcadis M2A SIO Report 2016)
  - Sample collected during the current assessment confirms this material to be an ACM.
- Concealed packing material on elbows throughout
  - This material has been identified in various RJ reports for other buildings at Matsqui Institution. As similar elbows of the same vintage were observed to be present in the subject building during the current assessment this material should be presumed to be present and considered ACM until proven otherwise through further sampling/analysis.
  - Stantec cannot obtain confirmatory samples without disassembling pipe elbows
- Bell and spigot housings throughout
  - This material has been identified in various RJ reports for other buildings at Matsqui Institution. As similar fittings of the same vintage were observed to be present in the subject building during the current assessment this material should be presumed to be present and considered ACM until proven otherwise through further sampling/analysis.
  - Stantec cannot obtain confirmatory samples without disassembling bell and spigot fittings
- Gaskets throughout
  - No suspected ACM mechanical gaskets were observed during the current assessment. ACM gaskets may remain present in inaccessible flanges or other inner components of mechanical equipment.

In addition to the above, Stantec identified and sampled various additional suspected ACMs and/or collected confirmatory samples of previously identified 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 current assessment, along with the sample locations and analytical results is presented in Table 5.19-1, 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 5.19-1 Suspected ACM Sample Collection and Analysis Summary Building M2A— Administrative Offices**

| Material/Homogenous Application Description | Sample Number | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| 1'x1' white ceiling tile with few fissures | M2A-CT-01A | Room 134a, office | None Detected |
| | M2A-CT-01B | Room 134a, office | None Detected |
| | M2A-CT-01C | Room 134a, office | None Detected |
| 1'x1' textured white ceiling tile | M2A-CT-02A | Room 134a, office | None Detected |
| | M2A-CT-02B | Room 134a, office | None Detected |
| | M2A-CT-02C | Room 134a, office | None Detected |
| **Grey vent caulking on HVAC intake** | **M2A-EUC-01A** | **Exterior south vent** | **1.3% Chrysotile** |
| | **M2A-EUC-01B** | **Exterior south vent** | **Positive Stop (Not Analyzed)** |
| | **M2A-EUC-01C** | **Exterior south vent** | **Positive Stop (Not Analyzed)** |
| Fire stop, block wall penetration | M2A-FS-01A | Room 127, mechanical room | None Detected |
| | M2A-FS-01B | Room 127, mechanical room | None Detected |
| | M2A-FS-01C | Room 127, mechanical room | None Detected |
| Grey pipe sealant applied to threads of sprinkler lines | M2A-PS-01A | Room 135, corridor | None Detected |
| | M2A-PS-01B | Room 101a, office | None Detected |
| | M2A-PS-01C | Room 104, H/R | None Detected |
| Red penetration putty on sprinkler penetrations | M2A-PP-01A | Room 134a, office | None Detected |
| | M2A-PP-01B | Room 134a, office | None Detected |
| | M2A-PP-01C | Room 134a, office | None Detected |
| Light grey penetration putty on exterior electrical box | M2A-PP-02A | Exterior south side | None Detected |
| | M2A-PP-02B | Exterior south side | None Detected |
| | M2A-PP-02C | Exterior south side | None Detected |
| Dark grey penetration putty on electrical conduit | M2A-PP-03A | Exterior south side | None Detected |
| | M2A-PP-03B | Exterior south side | None Detected |
| | M2A-PP-03C | Exterior south side | None Detected |
| Cream penetration putty on electrical penetrations | M2A-PP-04A | Exterior north side | None Detected |
| | M2A-PP-04B | Exterior north side | None Detected |
| | M2A-PP-04C | Exterior north side | None Detected |

**Table 5.19-1 Suspected ACM Sample Collection and Analysis Summary Building M2A— Administrative Offices**

| Material/Homogenous Application Description | Sample Number | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| Grey speckled penetration putty on electrical penetrations | M2A-PP-05A | Exterior north side | None Detected |
| | M2A-PP-05B | Exterior north side | None Detected |
| | M2A-PP-05C | Exterior north side | None Detected |
| Cream footing glue under raised flooring on 9”x9” floor tile | M2A-FG-01A | Room 136, MCCP computer room | None Detected |
| | M2A-FG-01B | Room 136, MCCP computer room | None Detected |
| | M2A-FG-01C | Room 136, MCCP computer room | None Detected |
| Black footing glue under raised flooring on 9”x9” floor tile | M2A-FG-02A | Room 136, MCCP computer room | None Detected |
| | M2A-FG-02B | Room 136, MCCP computer room | None Detected |
| | M2A-FG-02C | Room 136, MCCP computer room | None Detected |
| Drywall joint compound applied to walls and ceilings | M2A-DJC-01A | Room 134a, office, wall | None Detected |
| | M2A-DJC-01B | Room 135, corridor, wall | None Detected |
| | M2A-DJC-01C | Room 101a, office, wall | None Detected |
| | M2A-DJC-01D | Room 120, office, wall | None Detected |
| | M2A-DJC-01E | Room 135, corridor, wall | None Detected |
| Pipe wrap on domestic hot water lines | M2A-PW-01A | Room 104, H/R | None Detected |
| | M2A-PW-01B | Room 104, H/R | None Detected |
| | M2A-PW-01C | Room 104, H/R | None Detected |
| Pipe wrap on water lines | M2A-PW-02A | Room 127, mechanical room | None Detected |
| | M2A-PW-02B | Room 127, mechanical room | None Detected |
| | M2A-PW-02C-Wrap | Room 127, mechanical room | None Detected |
| | M2A-PW-02C-Tar | Room 127, mechanical room | None Detected |
| **Black pipe wrap on domestic cold-water lines** | **M2A-PW-03A** | **Room 114, stationary storage, pipe chase** | **5% Chrysotile** |
| | **M2A-PW-03B** | **Room 114, stationary storage, pipe chase** | **Positive Stop (Not Analyzed)** |
| | **M2A-PW-03C** | **Room 114, stationary storage, pipe chase** | **Positive Stop (Not Analyzed)** |
| Pipe wrap on rain water pipes | M2A-PW-04A | Room 121, office | None Detected |
| | M2A-PW-04B | Room 121, office | None Detected |
| | M2A-PW-04C | Room 121, office | None Detected |

**Table 5.19-1 Suspected ACM Sample Collection and Analysis Summary Building M2A— Administrative Offices**

| Material/Homogenous Application Description | Sample Number | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| Grey remnant wall sealant | M2A-WS-01A | Room 136, MCCP computer room | None Detected |
| | M2A-WS-01B | Room 136, MCCP computer room | None Detected |
| | M2A-WS-01C | Room 136, MCCP computer room | None Detected |
| Black ceiling tile glue on 1'x1' white ceiling tile with few fissures | M2A-CTG-01A | Room 134a, office | None Detected |
| | M2A-CTG-01B | Room 134a, office | None Detected |
| | M2A-CTG-01C | Room 134a, office | <0.36% Chrysotile (see 5.19.1.2) |
| Brown ceiling tile glue on 1'x1' textured white ceiling tile | M2A-CTG-02A | Room 136, MCCP computer room | None Detected |
| | M2A-CTG-02B | Room 136, MCCP computer room | None Detected |
| | M2A-CTG-02C | Room 136, MCCP computer room | None Detected |
| **White swirl pattern texture coat** | **M2A-TC-01A** | **Room 136, MCCP computer room** | **1% Chrysotile** |
| | **M2A-TC-01B** | **Room 136, MCCP computer room** | **Positive Stop (Not Analyzed)** |
| | **M2A-TC-01C** | **Room 136, MCCP computer room** | **Positive Stop (Not Analyzed)** |
| White texture coat | M2A-TC-02A | Room 140, entry | None Detected |
| | M2A-TC-02B | Room 140, entry | None Detected |
| | M2A-TC-02C | Room 140, entry | None Detected |
| Black Styrofoam glue within block walls | M2A-SG-01A | Room 113, finance room | None Detected |
| | M2A-SG-01B | Room 113, finance room | None Detected |
| | M2A-SG-01C | Room 113, finance room | None Detected |
| Tan seam sealant between concrete | M2A-SS-01A | Exterior seams | None Detected |
| | M2A-SS-01B | Exterior seams | None Detected |
| | M2A-SS-01C | Exterior seams | None Detected |
| Grey duct mastic on HVAC ducting | M2A-DM-01A | Room 127, mechanical room | None Detected |
| | M2A-DM-01B | Room 127, mechanical room | None Detected |
| | M2A-DM-01C | Room 127, mechanical room | None Detected |

**Table 5.19-1 Suspected ACM Sample Collection and Analysis Summary Building M2A— Administrative Offices**

| Material/Homogenous Application Description | Sample Number | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| **Gold duct mastic on HVAC ducting** | **M2A-DM-02A** | **Room 114, stationary storage** | **2.6% Chrysotile** |
| | **M2A-DM-02B** | **Room 114, stationary storage** | **Positive Stop (Not Analyzed)** |
| | **M2A-DM-02C** | **Room 114, stationary storage** | **Positive Stop (Not Analyzed)** |
| **White duct mastic on HVAC ducting** | **M2A-DM-03A** | **Room 116a, vestibule** | **2.0% Chrysotile** |
| | **M2A-DM-03B** | **Room 116a, vestibule** | **Positive Stop (Not Analyzed)** |
| | **M2A-DM-03C** | **Room 116a, vestibule** | **Positive Stop (Not Analyzed)** |
| Plaster applied to walls and ceilings | M2A-PL-01A | Room 127, mechanical room, ceiling | None Detected |
| | M2A-PL-01B | Room 128, women's washroom, wall | None Detected |
| | M2A-PL-01C | Room 114, stationary storage, wall | None Detected |
| | M2A-PL-01D | Room 116, showers/washroom | None Detected |
| | M2A-PL-01E | Room 116, showers/washroom | None Detected |
| Grey HVAC sealant | M2A-HS-01A | Room 127, mechanical room | None Detected |
| | M2A-HS-01B | Room 127, mechanical room | None Detected |
| | M2A-HS-01C | Room 127, mechanical room | None Detected |
| 2'x4' small and large pinhole ceiling tile | M2A-CT-03A | Room 135, corridor | None Detected |
| | M2A-CT-03B | Room 135, corridor | None Detected |
| | M2A-CT-03C | Room 135, corridor | None Detected |
| 1'x1' deep fissure ceiling tile | M2A-CT-04A | Room 138, central control | None Detected |
| | M2A-CT-04B | Room 138, central control | None Detected |
| | M2A-CT-04C | Room 138, central control | None Detected |
| Mastic associated with floor tiles, various sizes and styles, in various locations throughout | M2A-FTM-01A | Room 128, women's washroom | <0.25% Chrysotile (see 5.19.1.2) |
| | M2A-FTM-01B | Room 115, janitor | None Detected |
| | M2A-FTM-01C | Room 136, MCCP computer room | None Detected |
| **9"x9" floor tile with brown and white streaks** | **M2A-FT-01** | **Room 128, women's washroom** | **1.1% Chrysotile** |
| **12"x12" blue floor tile** | **M2A-FT-02** | **Room 115, janitor** | **2.1% Chrysotile** |

**Table 5.19-1 Suspected ACM Sample Collection and Analysis Summary Building M2A— Administrative Offices**

| Material/Homogenous Application Description | Sample Number | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| **Tan floor tile under linoleum** | **M2A-FT-03-Floor Tile** | **Room 135, corridor** | **5% Chrysotile** |
| Grey leveler associated with tan floor tile under linoleum | M2A-FT-03-Leveler | Room 135, corridor | None Detected |
| Grey floor tile under light blue with white and dark blue spotted sheet flooring | M2A-FT-04 | Room 135, corridor | None Detected |
| 12”x12” white/cream floor tile with light grey streaks | M2A-FT-05 | Room 137, corridor | None Detected |
| Black floor tile under 12”x12” white/cream floor tile with light grey streaks | M2A-FT-06 | Room 140, entry | None Detected (see 5.19.1.3) |
| **Tan 9”x9” floor tile with grey smears** | **M2A-FT-07-Floor Tile** | **Room 136, MCCP computer room** | **3.2% Chrysotile** |
| Black floor tile mastic associated with tan 9”x9” floor tile with grey smears | M2A-FT-07-Mastic | Room 136, MCCP computer room | None Detected |
| **Tan floor tile under light blue with white and dark blue spotted sheet flooring** | **M2A-FT-08** | **Room 124, office** | **1.0% Chrysotile** |
| **Light blue with white and dark blue spotted sheet flooring** | **M2A-SF-01** | **Room 135, corridor** | **5.9% Chrysotile** |
| Salmon pebble pattern sheet flooring | M2A-SF-02 | Room 134a, office | None Detected |
| Grey sheet flooring with white smudges | M2A-SF-03 | Room 101a, office | None Detected |
| Cream sheet flooring under grey sheet flooring with white smudges | M2A-SF-04 | Room 101a, office | None Detected |
| Tan sheet flooring | M2A-SF-05 | Room 138a, secure vestibule | 0.26% Chrysotile (see 5.19.1.2) |
| NOTE:<br>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 the results of suspected ACM samples analyzed through the current assessment along with our review of the information provided in the Previous Reports, the materials presented in Table 5.19-2, below were identified as an ACMs.

**Table 5.19-2 Summary of Identified ACMs**
**Building M2A— Administrative Offices**

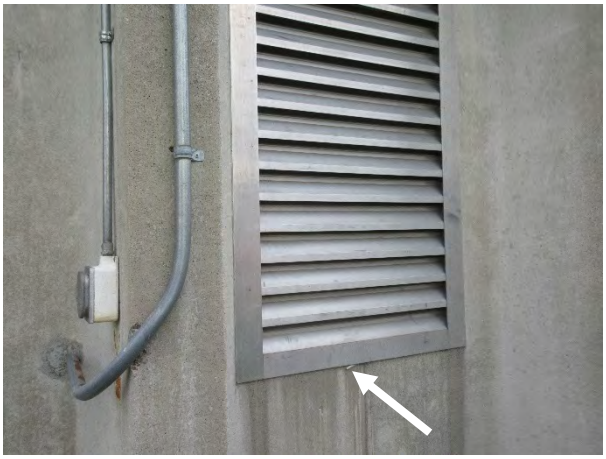
| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| **Grey caulking applied to exterior HVAC intake vent.** | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 6 linear metres | |
| Content | 1.3% Chrysotile | |
| **Tar paper jacket on fiberglass insulation (black mastic on pipe elbows/lagging/wrap).**<br>**Potentially also present, concealed within the pipe wrap itself, as part of older pipe wrap materials in locations that were not inspected as part of this assessment. (see section 5.19.1.1)** | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 750 linear metres | |
| Content | 5% Chrysotile | |

**Table 5.19-2 Summary of Identified ACMs
Building M2A— Administrative Offices**

| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| **White swirl pattern texture coat applied to the walls in room 136, MCCP computer room.** | |  |
| Friability | Non-friable in situ; potentially friable during renovation or demolition | |
| Condition | Good | |
| Total Quantity | Approximately 12 square metres | |
| Content | 1% Chrysotile | |
| **Mastic (silver/gold and in some instances painted white) applied to the seams of HVAC ducting throughout.** | |   |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 500 linear metres | |
| Content | 2.0 to 2.6% Chrysotile | |

**Table 5.19-2 Summary of Identified ACMs**
**Building M2A— Administrative Offices**

| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| **Concealed vinyl floor tiles the following locations: Room 135 corridor (under linoleum), Room 140 entry (under linoleum), Room 136 MCCP computer room (under raised floor), Room 123 office (under sheet flooring) and Room 124 office (under sheet flooring).** | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 186 square metres | |
| Content | 1.0 to 5% Chrysotile | |
| **9”x9” floor tile with brown and white streaks in Room 128 women’s washroom.** | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 11 square metres | |
| Content | 1.1% Chrysotile | |
| **12”x12” blue floor tile in Room 115 janitor.** | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 3 square metres | |
| Content | 2.1% Chrysotile | |

**Table 5.19-2 Summary of Identified ACMs
Building M2A— Administrative Offices**

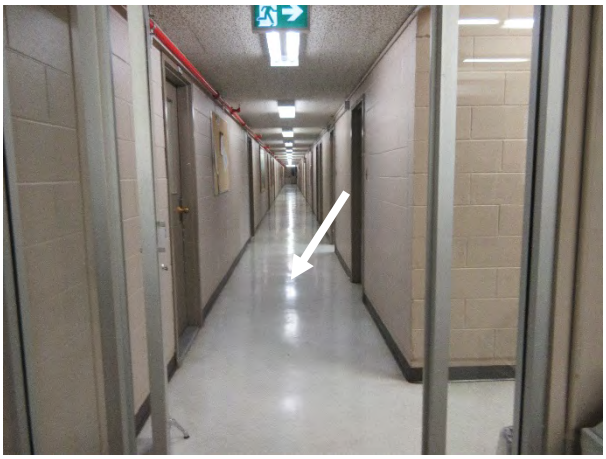
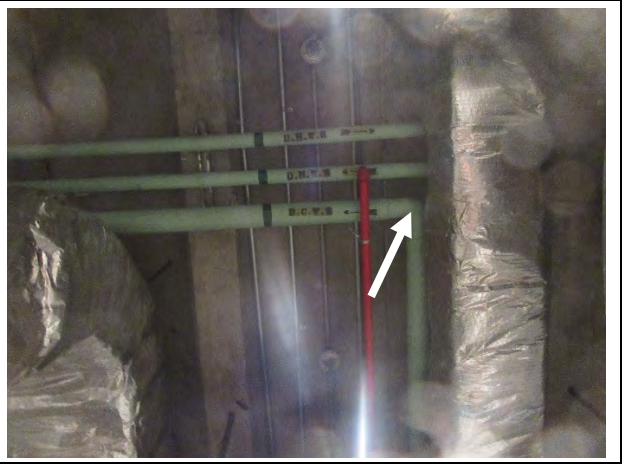
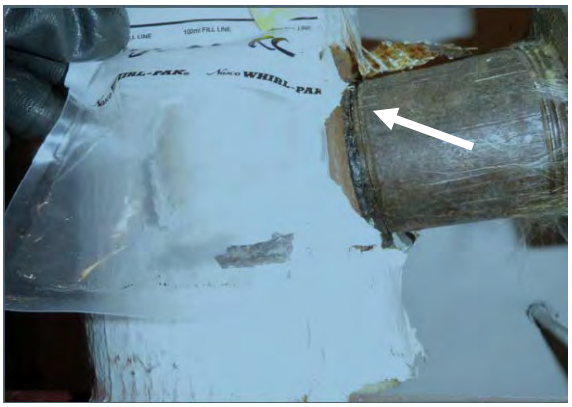
| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| **Light blue with white and dark blue spotted sheet flooring observed in Room 135 corridor, Room 113 finance (concealed under laminate), 116A vestibule and Rooms 123/124 offices. May be present in other locations concealed under other flooring materials.** | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 175 square metres | |
| Content | 5.9% Chrysotile | |
| **Cementitious insulation may be applied to pipe fittings in ceiling spaces, wall cavities or areas of the crawlspace not accessed as part of this assessment. This material should be presumed to be ACM until proven otherwise through further sampling/analysis.** | |  |
| Friability | Friable | |
| Condition | Not observed | |
| Total Quantity | Not observed | |
| Content | Not observed | |

**Table 5.19-2 Summary of Identified ACMs**
**Building M2A— Administrative Offices**

| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| **Concealed packing material inside pipe elbows throughout should be considered ACM until proven otherwise through further sampling/analysis.** | |  Photo from RJ, M10 Room 202 Report, 2010 |
| Friability | Non-friable | |
| Condition | Not observed | |
| Total Quantity | Not observed | |
| Content | 1 to 5% Chrysotile (note that this sample was collected in building M10 at Matsqui Institution, not in the subject building, RJ, M10 Room 202 Report, 2010) | |
| **Concealed material inside bell fittings throughout should be considered ACM until proven otherwise through further sampling/analysis.** | |  |
| Friability | Non-friable | |
| Condition | Not observed | |
| Total Quantity | Not observed | |
| Content | No sampling information was found within the previous reports | |
| **No suspected ACM mechanical gaskets were observed during the current assessment. ACM gaskets may remain present in inaccessible flanges or other inner components of mechanical equipment.** | | No photo |
| Friability | Non-friable | |
| Condition | Not observed | |
| Total Quantity | Not observed | |
| Content | No sampling information was found within the previous reports | |

### 5.19.1.1 Tar Paper Jacket

Tar paper jacketing, also described as black mastic on lagging, elbows or wrap, has been identified as an ACM in several buildings throughout Matsqui Institution including the subject building. It is believed to be associated with pipe insulation jacketing that was used during the original construction of buildings within the institution in the 1960s. The asbestos that has been detected in this material is present in the tar (black mastic) that is applied to the paper jacketing. In many instances the tar is concealed as an inner layer (sandwiched between two layers of paper) of the jacketing and cannot be identified without cutting into the jacketing. In addition, jacketing which looks visually similar from the outside, but which does not include the ACM tar layer is present in many of the same buildings. As such, this material must be identified on a location by location basis as it may be disturbed by future renovation or demolition activities.

### 5.19.1.2 Non-Friable Materials Containing Less Than 0.5% Asbestos

Sample results for black ceiling tile glue in room 134a, floor tile mastic in room 128 and sheet flooring in room 138a indicate asbestos content less than 0.36%, less than 0.25% and 0.26% chrysotile asbestos respectively. The other two samples of each material indicate no asbestos detected. The number of samples collected for these materials would be adequate to appropriately characterize their asbestos content based on their extents and published standards for sampling of homogenous applications of suspected ACMs (e.g., the Asbestos Guide). Given the analytical results and the non-friable nature of these materials, they would not be considered an ACMs.

### 5.19.1.3 Concealed Floor Tile in Room 140

Results for sample M2A-FT-06, which was collected in Room 140 indicate no asbestos detected. However, the hallways present in either direction from room 140 (room 135 in M2A and room 141 in M2B) both have identified ACM floor tile present as a concealed layer. As the extent of concealed floor tile cannot be confirmed, and as there is confirmed ACM concealed floor tile on both sides of Room 140, ACM concealed floor tile should also be expected in Room 140.

### 5.19.1.4 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 were made regarding areas where vermiculite is potentially present:

- Some walls of the subject building are comprised of brick and masonry blocks. To assess for the presence of vermiculite insulation the block wall cavity was drilled in two locations and no vermiculite was observed. Brick cavities were not drilled as part of this assessment.
- No other locations that may potentially contain vermiculite (that could not otherwise be assessed) were observed by Stantec

## 5.19-2 LEAD

Lead is expected to be present in the following within the subject building:

- Lead-acid batteries used in emergency lighting
- Older electrical wiring materials and sheathing
- Solder used on domestic water lines
- Solder used in bell fittings for cast iron pipes and in electrical equipment
- Ceramic tile glaze
- Vent and pipe flashings

With respect to paint, the following paints were considered LCPs through the Previous Reports based on an LCP definition criterion of 600 ppm lead (or greater), with notes regarding condition or other changes noted during the current assessment.

- Peach on concrete walls in room 135 corridor (Arcadis M2A SIO Report 2016)
  - Observed to present on concrete block walls throughout and in good condition

In addition to the above, chip samples were obtained from the predominant suspected LCP applications within the subject building. A summary of the sample types, locations and analytical results is presented in Table 5.19-3, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

**Table 5.19-3 Suspected LCP Sample Collection and Analysis Summary Building M2A— Administrative Offices**

| Sample No. | Sample Colour/Substrate | Sample Location | Lab Result (ppm) |
|---|---|---|---|
| M2A-P-01 | Tan on concrete and drywall | Room 101a, office | <83 |
| M2A-P-02 | Brown on wood | Room 101a, office, doors and frames | <82 |
| **M2A-P-03** | **Grey on concrete** | **Room 127, mechanical room, floors** | **1,100** |
| **M2A-P-04** | **Grey on metal** | **Room 127, mechanical room, stairs and railing** | **23,000** |
| **M2A-P-05** | **Light blue on wood** | **Room 127, mechanical room, doors** | **4,100** |
| M2A-P-06 | Cream on concrete | Exterior walls | <82 |
| **M2A-P-07** | **Light blue on metal** | **Exterior doors** | **760** |
| M2A-P-08 | Yellow on metal | Exterior bollards | <93 |

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 5.19-4, below were identified as LCPs:

**Table 5.19-4 Summary of Identified LCPs**
**Building M2A—Administrative Offices**

| Identified LCP Description | | Photo |
|---|---|---|
| Paint colour | Grey |  |
| Substrate | Concrete | |
| Location/approx. extent | Floor in Room 127 mechanical room | |
| Lead content | 1,100 ppm | |
| Condition | Good | |
| Paint colour | Grey |  |
| Substrate | Metal | |
| Location/approx. extent | Stairs and railing in Room 127 mechanical room | |
| Lead content | 23,000 ppm | |
| Condition | Good | |
| Paint colour | Light blue |  |
| Substrate | Wood | |
| Location/approx. extent | Various doors throughout | |
| Lead content | 4,100 ppm | |
| Condition | Good | |

**Table 5.19-4 Summary of Identified LCPs
Building M2A—Administrative Offices**

| Identified LCP Description | | Photo |
|---|---|---|
| Paint colour | Light blue |  |
| Substrate | Metal | |
| Location/approx. extent | Exterior doors | |
| Lead content | 760 ppm | |
| Condition | Good | |
| Paint colour | Peach |  |
| Substrate | Concrete | |
| Location/approx. extent | Interior walls throughout | |
| Lead content | 970 ppm (Arcadis M2A SIO Report 2016) | |
| Condition | Good | |

## 5.19-3 POLYCHLORINATED BIPHENYLS

PCBs may be present in the fluorescent light ballasts of the approximately 250 light fixtures observed. As the ballasts were energized, they could not be inspected at the time of the assessment for health and safety reasons.

## 5.19-4 MERCURY

Mercury vapour is present in the light tubes within the approximately 250 fluorescent light fixtures observed.

## 5.19-5 MOULD

The observations pertaining to mould and/or moisture that were made during this assessment are summarized in Table 5.19-5, below.

**Table 5.19-5 Mould/Moisture Observations Summary—November 5, 2018**
**Building M2A—Administrative Offices**

| Building Area | Observation | Suspected Source of Moisture | Photo |
|---|---|---|---|
| Various locations throughout | Moisture-stained ceiling tiles | Roof leaks, pipe leaks, HVAC condensation tray overflow |  |

## 5.19-6 OZONE-DEPLETING SUBSTANCES

The following equipment was identified by labels to be ODS-containing:

- One Mitsubishi HVAC unit servicing room 113, finance (R-22, 4.4 kg)

## 5.19-7 SILICA

Silica is expected to be present in the following, which were observed in various locations throughout:

- Cement products such as:
  - Concrete—foundations, floors, walls, blocks
  - Brick/masonry units and associated grout and mortar
  - Stone/ceramic floor tiles and associated grouts and mortars
- Gypsum and associated wall/ceiling finish materials
- Plaster and associated wall/ceiling finish materials
- Ceiling tiles
- Asphalt and asphalt products containing rock or stone (e.g., roof membrane)

# 6.19 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.

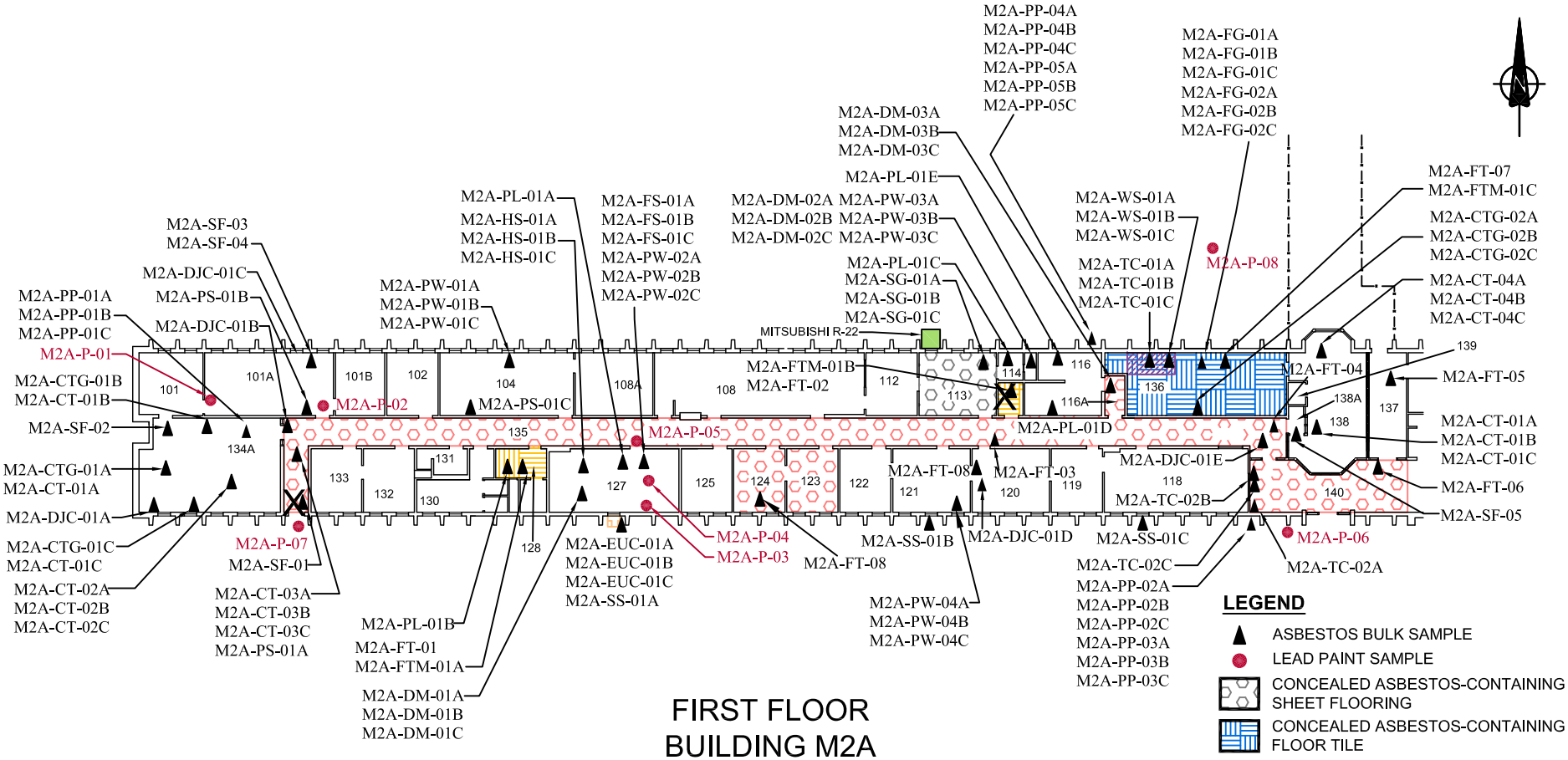
## 6.19-5 MOULD

Documents published by Health Canada, Ontario Ministry of Health, AIHA, ACGIH and others, provide guidance for interpreting the results of mould 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.
  - This work can be conducted by regular facility maintenance staff, if conducted prior to the onset of mould growth




# FIRST FLOOR
# BUILDING M2A
# ADMINISTRATIVE OFFICES

## LEGEND

- ASBESTOS BULK SAMPLE
- LEAD PAINT SAMPLE
- CONCEALED ASBESTOS-CONTAINING SHEET FLOORING
- CONCEALED ASBESTOS-CONTAINING FLOOR TILE
- EXPOSED ASBESTOS-CONTAINING FLOOR TILE
- EXPOSED ASBESTOS-CONTAINING SHEET FLOORING AND CONCEALED ACM FLOOR TILE
- ASBESTOS-CONTAINING GREY VENT CAULKING
- ASBESTOS-CONTAINING TEXTURE COAT WALLS
- ODS-CONTAINING EQUIPMENT
- X INTRUSIVE INVESTIGATION FOR VERMICULITE

**NOTES:**

1. TAR PAPER JACKET ON FIBREGLASS INSULATION IS ASBESTOS-CONTAINING WHERE PRESENT THROUGHOUT.
2. SILVER/GOLD (IN SOME INSTANCES PAINTED WHITE) DUCT MASTIC ON HVAC DUCTING THROUGHOUT IS ASBESTOS-CONTAINING.
3. CEMENTITIOUS INSULATION APPLIED TO PIPE FITTINGS WHERE DISCOVERED THROUGHOUT SHOULD BE PRESUMED TO BE ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.
4. CONCEALED PACKING MATERIAL INSIDE PIPE ELBOWS THROUGHOUT SHOULD BE CONSIDERED ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING ANALYSIS.
5. CONCEALED MATERIAL INSIDE BELL FITTINGS THROUGHOUT SHOULD BE CONSIDERED ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.
6. ASBESTOS-CONTAINING MECHANICAL GASKETS MAY BE PRESENT IN INACCESSIBLE FLANGES OR OTHER INNER COMPONENTS OF MECHANICAL EQUIPMENT THROUGHOUT.
7. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

MATSQUI INSTITUTION
33344 KING ROAD, ABBOTSFORD, BC

**Client:** PUBLIC SERVICES AND PROCUREMENT CANADA

| | |
|---|---|
| **Project No.:** | 123221180 |
| **Scale:** | N.T.S. |
| **Date:** | 19/03/27 |
| **Dwn. By:** | CD SL2019030489 VM/DM |
| **App'd By:** | TW |

**Dwg. No.:** 19.1

Stantec

| BUILDING M2A | | |
|---|---|---|
| Administrative Offices - First Floor | | |
| Rm# | Name | Area m2 |
| 101 | Office | 18.05 |
| 101A | Office | 33.32 |
| 101B | Office | 13.14 |
| 102 | Office | 13.56 |
| 104 | H/R | 34.56 |
| 108 | Finance | 54.04 |
| 108A | H/R Chief | 20.26 |
| 112 | Finance | 13.51 |
| 113 | FInance | 20.26 |
| 114 | Statlonary Storage | 3.68 |
| 115 | Janitor | 3.09 |
| 116 | Shower/Washroom | 20.25 |
| 116A | Vestibule | 3.18 |
| 118 | Corr. Manager | 37.46 |
| 119 | Photocopy Room | 13.62 |
| 120 | Offlce | 20.43 |
| 121 | Office | 20.43 |
| 122 | Office | 13.62 |
| 123 | Office | 13.62 |
| 124 | Office | 13.62 |
| 125 | Office | 13.62 |
| 127 | Mechanical Room | 34.06 |
| 128 | Women's Washroom | 10.84 |
| 130 | Women's Washroom | 17.74 |
| 131 | Men's Washroom | 5.48 |
| 132 | Office | 13.62 |
| 133 | Office | 13.62 |
| 134A | Offlce | 51.81 |
| 135 | Corridor | 110.94 |
| 136 | MCCP Computer Room | 43.87 |
| 137 | Corridor | 15.68 |
| 138 | Central Control | 32.18 |
| 138A | Secure Vestibule | 1.77 |
| 139 | Washroom | 1.50 |
| 140 | Entry | 71.53 |

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

MATSQUI INSTITUTION
33344 KING ROAD, ABBOTSFORD, BC

**Client:** PUBLIC SERVICES AND PROCUREMENT CANADA

| | |
|---|---|
| **Project No.:** | 123221180 |
| **Scale:** | N.T.S. |
| **Date:** | 19/02/16 |
| **Dwn. By:** | CD CS SL2019020314 |
| **App'd By:** | TW |

**Dwg. No.:** 19.2

Stantec

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

**Attn:** Kim Wiese
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 11/28/2018
Analyzed: 12/05/2018

**Proj:** 123221180-M2A-ADMINISTRATIVE OFFICE

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-CT-01A ***Lab Sample ID:*** **691803194-0001**
***Sample Description:*** Room 134a, office/1'x1' white ceiling tile with few fissures

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 25.0% | 75.0% | None Detected | |

***Client Sample ID:*** M2A-CT-01B ***Lab Sample ID:*** **691803194-0002**
***Sample Description:*** Room 134a, office/1'x1' white ceiling tile with few fissures

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 65.0% | 35.0% | None Detected | |

***Client Sample ID:*** M2A-CT-01C ***Lab Sample ID:*** **691803194-0003**
***Sample Description:*** Room 134a, office/1'x1' white ceiling tile with few fissures

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 80.0% | 20.0% | None Detected | |

***Client Sample ID:*** M2A-CT-02A ***Lab Sample ID:*** **691803194-0004**
***Sample Description:*** Room 134a, office/1'x1' textured white ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Yellow | 75.0% | 25.0% | None Detected | |

***Client Sample ID:*** M2A-CT-02B ***Lab Sample ID:*** **691803194-0005**
***Sample Description:*** Room 134a, office/1'x1' textured white ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White/Yellow | 45.0% | 55.0% | None Detected | |

***Client Sample ID:*** M2A-CT-02C ***Lab Sample ID:*** **691803194-0006**
***Sample Description:*** Room 134a, office/1'x1' textured white ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White/Yellow | 20.0% | 80.0% | None Detected | |

***Client Sample ID:*** M2A-EUC-01A ***Lab Sample ID:*** **691803194-0007**
***Sample Description:*** Exterior south vent/Grey vent caulking on HVAC intake

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 98.7% | **1.3% Chrysotile** | |

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-EUC-01B ***Lab Sample ID:*** **691803194-0008**

***Sample Description:*** Exterior south vent/Grey vent caulking on HVAC intake

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | | | Positive Stop (Not Analyzed) | | |

***Client Sample ID:*** M2A-EUC-01C ***Lab Sample ID:*** **691803194-0009**

***Sample Description:*** Exterior south vent/Grey vent caulking on HVAC intake

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | | | Positive Stop (Not Analyzed) | | |

***Client Sample ID:*** M2A-FS-01A ***Lab Sample ID:*** **691803194-0010**

***Sample Description:*** Room 127, mechanical room/Fire stop, block wall penetration

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FS-01B ***Lab Sample ID:*** **691803194-0011**

***Sample Description:*** Room 127, mechanical room/Fire stop, block wall penetration

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FS-01C ***Lab Sample ID:*** **691803194-0012**

***Sample Description:*** Room 127, mechanical room/Fire stop, block wall penetration

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PS-01A ***Lab Sample ID:*** **691803194-0013**

***Sample Description:*** Room 135, corridor/Grey pipe sealant applied to threads of sprinkler lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | <0.71% | 100% | None Detected | |

***Client Sample ID:*** M2A-PS-01B ***Lab Sample ID:*** **691803194-0014**

***Sample Description:*** Room 101a, office/Grey pipe sealant applied to threads of sprinkler lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Red | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PS-01C ***Lab Sample ID:*** **691803194-0015**

***Sample Description:*** Room 104, H/R/Grey pipe sealant applied to threads of sprinkler lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-PP-01A ***Lab Sample ID:*** **691803194-0016**

***Sample Description:*** Room 134a, office/Red penetration putty on sprinkler penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Red | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-01B ***Lab Sample ID:*** **691803194-0017**

***Sample Description:*** Room 134a, office/Red penetration putty on sprinkler penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Red | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-01C ***Lab Sample ID:*** **691803194-0018**

***Sample Description:*** Room 134a, office/Red penetration putty on sprinkler penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Red | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-02A ***Lab Sample ID:*** **691803194-0019**

***Sample Description:*** Exterior south side/Light grey penetration putty on exterior electrical box

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-02B ***Lab Sample ID:*** **691803194-0020**

***Sample Description:*** Exterior south side/Light grey penetration putty on exterior electrical box

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-02C ***Lab Sample ID:*** **691803194-0021**

***Sample Description:*** Exterior south side/Light grey penetration putty on exterior electrical box

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-03A ***Lab Sample ID:*** **691803194-0022**

***Sample Description:*** Exterior south side/Dark grey penetration putty on electrical conduit

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-PP-03B ***Lab Sample ID:*** **691803194-0023**

***Sample Description:*** Exterior south side/Dark grey penetration putty on electrical conduit

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Black | 0.0% | 100% | None Detected | |

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-PP-03C ***Lab Sample ID:*** **691803194-0024**
***Sample Description:*** Exterior south side/Dark grey penetration putty on electrical conduit

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-PP-04A ***Lab Sample ID:*** **691803194-0025**
***Sample Description:*** Exterior north side/Cream penetration putty on electrical penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-04B ***Lab Sample ID:*** **691803194-0026**
***Sample Description:*** Exterior north side/Cream penetration putty on electrical penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-04C ***Lab Sample ID:*** **691803194-0027**
***Sample Description:*** Exterior north side/Cream penetration putty on electrical penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PP-05A ***Lab Sample ID:*** **691803194-0028**
***Sample Description:*** Exterior north side/Grey speckled penetration putty on electrical penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-PP-05B ***Lab Sample ID:*** **691803194-0029**
***Sample Description:*** Exterior north side/Grey speckled penetration putty on electrical penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-PP-05C ***Lab Sample ID:*** **691803194-0030**
***Sample Description:*** Exterior north side/Grey speckled penetration putty on electrical penetrations

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FG-01A ***Lab Sample ID:*** **691803194-0031**
***Sample Description:*** Room 136, MCCP computer room/Cream footing glue under raised flooring on 9”x9” floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/White | 0.0% | 100% | None Detected | |

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Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-FG-01B ***Lab Sample ID:*** **691803194-0032**

***Sample Description:*** Room 136, MCCP computer room/Cream footing glue under raised flooring on 9”x9 floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FG-01C ***Lab Sample ID:*** **691803194-0033**

***Sample Description:*** Room 136, MCCP computer room/Cream footing glue under raised flooring on 9”x9” floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FG-02A ***Lab Sample ID:*** **691803194-0034**

***Sample Description:*** Room 136, MCCP computer room/Black footing glue under raised flooring on 9”x9” floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FG-02B ***Lab Sample ID:*** **691803194-0035**

***Sample Description:*** Room 136, MCCP computer room/Black footing glue under raised flooring on 9”x9” floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FG-02C ***Lab Sample ID:*** **691803194-0036**

***Sample Description:*** Room 136, MCCP computer room/Black footing glue under raised flooring on 9”x9” floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-DJC-01A ***Lab Sample ID:*** **691803194-0037**

***Sample Description:*** Room 134a, office, wall/Drywall joint compound applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-DJC-01B ***Lab Sample ID:*** **691803194-0038**

***Sample Description:*** Room 135, corridor, wall/Drywall joint compound applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-DJC-01C ***Lab Sample ID:*** **691803194-0039**

***Sample Description:*** Room 101a, office, wall/Drywall joint compound applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-DJC-01D ***Lab Sample ID:*** **691803194-0040**

***Sample Description:*** Room 120, office, wall/Drywall joint compound applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-DJC-01E ***Lab Sample ID:*** **691803194-0041**

***Sample Description:*** Room 135, corridor, wall/Drywall joint compound applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-01A ***Lab Sample ID:*** **691803194-0042**

***Sample Description:*** Room 104, H/R/Pipe wrap on domestic hot water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray/Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-01B ***Lab Sample ID:*** **691803194-0043**

***Sample Description:*** Room 104, H/R/Pipe wrap on domestic hot water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-01C ***Lab Sample ID:*** **691803194-0044**

***Sample Description:*** Room 104, H/R/Pipe wrap on domestic hot water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-02A ***Lab Sample ID:*** **691803194-0045**

***Sample Description:*** Room 127, mechanical room/Pipe wrap on water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 45.0% | 55.0% | None Detected | |

***Client Sample ID:*** M2A-PW-02B ***Lab Sample ID:*** **691803194-0046**

***Sample Description:*** Room 127, mechanical room/Pipe wrap on water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-02C-Wrap ***Lab Sample ID:*** **691803194-0047**

***Sample Description:*** Room 127, mechanical room/Pipe wrap on water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 80.0% | 20.0% | None Detected | |

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-PW-02C-Tar ***Lab Sample ID:*** **691803194-0047A**

***Sample Description:*** Room 127, mechanical room/Pipe wrap on water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-03A ***Lab Sample ID:*** **691803194-0048**

***Sample Description:*** Room 114, stationary storage, pipe chase/Black pipe wrap on domestic cold water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 95.0% | **5% Chrysotile** | |

***Client Sample ID:*** M2A-PW-03B ***Lab Sample ID:*** **691803194-0049**

***Sample Description:*** Room 114, stationary storage, pipe chase/Black pipe wrap on domestic cold water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-PW-03C ***Lab Sample ID:*** **691803194-0050**

***Sample Description:*** Room 114, stationary storage, pipe chase/Black pipe wrap on domestic cold water lines

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-PW-04A ***Lab Sample ID:*** **691803194-0051**

***Sample Description:*** Room 121, office/Pipe wrap on rain water pipes

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-04B ***Lab Sample ID:*** **691803194-0052**

***Sample Description:*** Room 121, office/Pipe wrap on rain water pipes

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PW-04C ***Lab Sample ID:*** **691803194-0053**

***Sample Description:*** Room 121, office/Pipe wrap on rain water pipes

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Yellow | 70.0% | 30.0% | None Detected | |

***Client Sample ID:*** M2A-WS-01A ***Lab Sample ID:*** **691803194-0054**

***Sample Description:*** Room 136, MCCP computer room/Grey remnant wall sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Black | 0.0% | 100% | None Detected | |

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EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-WS-01B **Lab Sample ID:** **691803194-0055**

***Sample Description:*** Room 136, MCCP computer room/Grey remnant wall sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-WS-01C **Lab Sample ID:** **691803194-0056**

***Sample Description:*** Room 136, MCCP computer room/Grey remnant wall sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-CTG-01A **Lab Sample ID:** **691803194-0057**

***Sample Description:*** Room 134a, office/Black ceiling tile glue on 1'x1' white ceiling tile with few fissures

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Brown | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-CTG-01B **Lab Sample ID:** **691803194-0058**

***Sample Description:*** Room 134a, office/Black ceiling tile glue on 1'x1' white ceiling tile with few fissures

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Brown | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-CTG-01C **Lab Sample ID:** **691803194-0059**

***Sample Description:*** Room 134a, office/Black ceiling tile glue on 1'x1' white ceiling tile with few fissures

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Brown | 0.0% | 100% | **<0.36% Chrysotile** | |

***Client Sample ID:*** M2A-CTG-02A **Lab Sample ID:** **691803194-0060**

***Sample Description:*** Room 136, MCCP computer room/Brown ceiling tile glue on 1'x1' textured white ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Beige | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-CTG-02B **Lab Sample ID:** **691803194-0061**

***Sample Description:*** Room 136, MCCP computer room/Brown ceiling tile glue on 1'x1' textured white ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Beige | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-CTG-02C **Lab Sample ID:** **691803194-0062**

***Sample Description:*** Room 136, MCCP computer room/Brown ceiling tile glue on 1'x1' textured white ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Beige | 0.0% | 100% | None Detected | |

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## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-TC-01A **Lab Sample ID:** **691803194-0063**

***Sample Description:*** Room 136, MCCP computer room/White swirl pattern texture coat

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 99.0% | 1% Chrysotile | |

***Client Sample ID:*** M2A-TC-01B **Lab Sample ID:** **691803194-0064**

***Sample Description:*** Room 136, MCCP computer room/White swirl pattern texture coat

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-TC-01C **Lab Sample ID:** **691803194-0065**

***Sample Description:*** Room 136, MCCP computer room/White swirl pattern texture coat

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-TC-02A **Lab Sample ID:** **691803194-0066**

***Sample Description:*** Room 140, entry/White texture coat

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-TC-02B **Lab Sample ID:** **691803194-0067**

***Sample Description:*** Room 140, entry/White texture coat

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-TC-02C **Lab Sample ID:** **691803194-0068**

***Sample Description:*** Room 140, entry/White texture coat

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-SG-01A **Lab Sample ID:** **691803194-0069**

***Sample Description:*** Room 113, finance room/Black Styrofoam glue within block walls

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White/Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-SG-01B **Lab Sample ID:** **691803194-0070**

***Sample Description:*** Room 113, finance room/Black Styrofoam glue within block walls

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White/Black | 0.0% | 100% | None Detected | |

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## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-SG-01C **Lab Sample ID:** **691803194-0071**
***Sample Description:*** Room 113, finance room/Black Styrofoam glue within block walls

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White/Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-SS-01A **Lab Sample ID:** **691803194-0072**
***Sample Description:*** Exterior seams/Tan seam sealant between concrete

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-SS-01B **Lab Sample ID:** **691803194-0073**
***Sample Description:*** Exterior seams/Tan seam sealant between concrete

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-SS-01C **Lab Sample ID:** **691803194-0074**
***Sample Description:*** Exterior seams/Tan seam sealant between concrete

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-DM-01A **Lab Sample ID:** **691803194-0075**
***Sample Description:*** Room 127, mechanical room/Grey duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-DM-01B **Lab Sample ID:** **691803194-0076**
***Sample Description:*** Room 127, mechanical room/Grey duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-DM-01C **Lab Sample ID:** **691803194-0077**
***Sample Description:*** Room 127, mechanical room/Grey duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-DM-02A **Lab Sample ID:** **691803194-0078**
***Sample Description:*** Room 114, stationary storage/Gold duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/Gold | 0.0% | 97.4% | **2.6% Chrysotile** | |

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## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-DM-02B **Lab Sample ID:** **691803194-0079**

***Sample Description:*** Room 114, stationary storage/Gold duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-DM-02C **Lab Sample ID:** **691803194-0080**

***Sample Description:*** Room 114, stationary storage/Gold duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-DM-03A **Lab Sample ID:** **691803194-0081**

***Sample Description:*** Room 116a, vestibule/White duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/Gold | 0.0% | 98.0% | **2.0% Chrysotile** | |

***Client Sample ID:*** M2A-DM-03B **Lab Sample ID:** **691803194-0082**

***Sample Description:*** Room 116a, vestibule/White duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-DM-03C **Lab Sample ID:** **691803194-0083**

***Sample Description:*** Room 116a, vestibule/White duct mastic on HVAC ducting

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | | | | Positive Stop (Not Analyzed) | |

***Client Sample ID:*** M2A-PL-01A **Lab Sample ID:** **691803194-0084**

***Sample Description:*** Room 127, mechanical room, ceiling/Plaster applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PL-01B **Lab Sample ID:** **691803194-0085**

***Sample Description:*** Room 128, womens washroom, wall/Plaster applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PL-01C **Lab Sample ID:** **691803194-0086**

***Sample Description:*** Room 114, stationary storage, wall/Plaster applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

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## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-PL-01D ***Lab Sample ID:*** **691803194-0087**

***Sample Description:*** Room 116, showers/washroom/Plaster applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-PL-01E ***Lab Sample ID:*** **691803194-0088**

***Sample Description:*** Room 116, showers/washroom/Plaster applied to walls and ceilings

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | White | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-HS-01A ***Lab Sample ID:*** **691803194-0089**

***Sample Description:*** Room 127, mechanical room/Grey HVAC sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-HS-01B ***Lab Sample ID:*** **691803194-0090**

***Sample Description:*** Room 127, mechanical room/Grey HVAC sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-HS-01C ***Lab Sample ID:*** **691803194-0091**

***Sample Description:*** Room 127, mechanical room/Grey HVAC sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-CT-03A ***Lab Sample ID:*** **691803194-0092**

***Sample Description:*** Room 135, corridor/2'x4' small and large pinhole ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 65.0% | 35.0% | None Detected | |

***Client Sample ID:*** M2A-CT-03B ***Lab Sample ID:*** **691803194-0093**

***Sample Description:*** Room 135, corridor/2'x4' small and large pinhole ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 90.0% | 10.0% | None Detected | |

***Client Sample ID:*** M2A-CT-03C ***Lab Sample ID:*** **691803194-0094**

***Sample Description:*** Room 135, corridor/2'x4' small and large pinhole ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 80.0% | 20.0% | None Detected | |

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## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-CT-04A **Lab Sample ID:** **691803194-0095**

***Sample Description:*** Room 138, central control/1'x1' deep fissure ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 80.0% | 20.0% | None Detected | |

***Client Sample ID:*** M2A-CT-04B **Lab Sample ID:** **691803194-0096**

***Sample Description:*** Room 138, central control/1'x1' deep fissure ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 90.0% | 10.0% | None Detected | |

***Client Sample ID:*** M2A-CT-04C **Lab Sample ID:** **691803194-0097**

***Sample Description:*** Room 138, central control/1'x1' deep fissure ceiling tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FTM-01A **Lab Sample ID:** **691803194-0098**

***Sample Description:*** Room 128, women's washroom/Mastic associated with floor tiles, various sizes and styles

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/Pink | 0.0% | 100% | **<0.25% Chrysotile** | |

***Client Sample ID:*** M2A-FTM-01B **Lab Sample ID:** **691803194-0099**

***Sample Description:*** Room 115, janitor/Mastic associated with floor tiles, various sizes and styles

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FTM-01C **Lab Sample ID:** **691803194-0100**

***Sample Description:*** Room 136, MCCP computer room/Mastic associated with floor tiles, various sizes and styles

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FT-01 **Lab Sample ID:** **691803194-0101**

***Sample Description:*** Room 128, women's washroom/9"x9" floor tile with brown and white streaks

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Pink | 0.0% | 98.9% | **1.1% Chrysotile** | |

***Client Sample ID:*** M2A-FT-02 **Lab Sample ID:** **691803194-0102**

***Sample Description:*** Room 115, janitor/12"x12" blue floor tile

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Blue | 0.0% | 97.9% | **2.1% Chrysotile** | |

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## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-FT-03-Floor Tile ***Lab Sample ID:*** **691803194-0103**

***Sample Description:*** Room 135, corridor/Tan floor tile under linoleum

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 95.0% | **5% Chrysotile** | |

***Client Sample ID:*** M2A-FT-03-Leveler ***Lab Sample ID:*** **691803194-0103A**

***Sample Description:*** Room 135, corridor/Tan floor tile under linoleum

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Gray | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FT-04 ***Lab Sample ID:*** **691803194-0104**

***Sample Description:*** Room 135, corridor/Grey floor tile under light blue with white and dark blue spotted sheet flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FT-05 ***Lab Sample ID:*** **691803194-0105**

***Sample Description:*** Room 137, corridor/12”x12” white/cream floor tile with light grey streaks

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FT-06 ***Lab Sample ID:*** **691803194-0106**

***Sample Description:*** Room 140, entry/Black floor tile under 12”x12” white/cream floor tile with light grey streaks

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-FT-07-Floor Tile ***Lab Sample ID:*** **691803194-0107**

***Sample Description:*** Room 136, MCCP computer room/Tan 9”x9” floor tile with grey smears

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/White | 0.0% | 96.8% | **3.2% Chrysotile** | |

***Client Sample ID:*** M2A-FT-07-Mastic ***Lab Sample ID:*** **691803194-0107A**

***Sample Description:*** Room 136, MCCP computer room/Tan 9”x9” floor tile with grey smears

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 12/05/2018 | Black | 0.0% | 100.0% | None Detected | |

***Client Sample ID:*** M2A-FT-08 ***Lab Sample ID:*** **691803194-0108**

***Sample Description:*** Room 124, office/Tan floor tile under light blue with white and dark blue spotted sheet flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 99.0% | **1.0% Chrysotile** | |

# EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com


EMSL Canada Order 691803194
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** M2A-SF-01 ***Lab Sample ID:*** **691803194-0109**

***Sample Description:*** Room 135, corridor/Light blue with white and dark blue spotted sheet flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray | 0.0% | 94.1% | **5.9% Chrysotile** | |

***Client Sample ID:*** M2A-SF-02 ***Lab Sample ID:*** **691803194-0110**

***Sample Description:*** Room 134a, office/Salmon pebble pattern sheet flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Gray/Pink | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-SF-03 ***Lab Sample ID:*** **691803194-0111**

***Sample Description:*** Room 101a, office/Grey sheet flooring with white smudges

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | Pink | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-SF-04 ***Lab Sample ID:*** **691803194-0112**

***Sample Description:*** Room 101a, office/Cream sheet flooring under grey sheet flooring with white smudges

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** M2A-SF-05 ***Lab Sample ID:*** **691803194-0113**

***Sample Description:*** Room 138a, secure vestibule/Tan sheet flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 12/05/2018 | White | 0.0% | 99.7% | **0.26% Chrysotile** | |

**Analyst(s):**

Chloe Huang PLM (42)
PLM Grav. Reduction (7)
Nicole Yeo PLM (19)
PLM Grav. Reduction (38)

**Reviewed and approved by:**

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Report amended: 04/11/201915:53:05 Replaces amended report from: 03/29/201916:08:13 Reason Code: Client-Change to Location

**EMSL Canada Inc.**
**2756 Slough Street, Mississauga, ON L4T 1G3**
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

| | |
|---|---|
| EMSL Canada Or | 551814226 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123221180 |
| ProjectID: | |

Attn: **Kim Wiese**
**Stantec Consulting Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 11/28/18 10:43 AM
Collected:

Project: **123221180**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client SampleDescription* | *Collected* | *Analyzed* | *Weight* | *RDL* | *Lead Concentration* |
|---|---|---|---|---|---|
| M2A-P-01 | | 11/30/2018 | 0.2416 g | 83 ppm | <83 ppm |
| *551814226-0001* | Site: M2A - ADMINISTRATIVE OFFICES -TAN ON CONCRETE AND DRYWALL - ROOM 101a, OFFICE, WALLS | | | | |
| M2A-P-02 | | 11/30/2018 | 0.2445 g | 82 ppm | <82 ppm |
| *551814226-0002* | Site: M2A - ADMINISTRATIVE OFFICES - BROWN ON WOOD - ROOM 101A, OFFICE, DOOR AND FRAMES | | | | |
| M2A-P-03 | | 11/30/2018 | 0.2478 g | 81 ppm | 1100 ppm |
| *551814226-0003* | Site: M2A - ADMINISTRATIVE OFFICES - GREY ON CONCRETE - ROOM 127, MECHANICAL ROOM, FLOORS | | | | |
| M2A-P-04 | | 11/30/2018 | 0.2402 g | 830 ppm | 23000 ppm |
| *551814226-0004* | Site: M2A - ADMINISTRATIVE OFFICES - GREY ON METAL - ROOM 127, MECHANICAL ROOM, STAIRS AND RAILING | | | | |
| M2A-P-05 | | 11/30/2018 | 0.1770 g | 110 ppm | 4100 ppm |
| *551814226-0005* | Site: M2A - ADMINISTRATIVE OFFICES - LIGHT BLUE ON WOOD - ROOM 137, MECHANICAL ROOM , DOORS | | | | |
| M2A-P-06 | | 11/30/2018 | 0.2444 g | 82 ppm | <82 ppm |
| *551814226-0006* | Site: M2A - ADMINISTRATIVE OFFICES - CREAM ON CONCRETE - EXTERIOR WALLS | | | | |
| M2A-P-07 | | 11/30/2018 | 0.2427 g | 82 ppm | 760 ppm |
| *551814226-0007* | Site: M2A - ADMINISTRATIVE OFFICES - LIGHT BLUE ON METAL - EXTERIOR DOORS | | | | |
| M2A-P-08 | | 11/30/2018 | 0.2155 g | 93 ppm | <93 ppm |
| *551814226-0008* | Site: M2A - ADMINISTRATIVE OFFICES - YELLOW ON METAL - EXTERIOR BOLLARDS<br>Insufficient sample to reach reporting limit. | | | | |

Rowena Fanto, Lead Supervisor
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Cert #2845.08; AIHA-LAP, LLC - ELLAP #196142

Report Amended: 04/08/2019 09:00:27 Replaces Report Amended: 03/26/2019 16:35:15. Reason Code: Client-Other (see report comment)

# APPENDIX B
# CONTRACTOR NOTIFICATION AND AKNOWLEDGEMENT

# ASBESTOS AND OTHER HAZMAT WORK NOTICE FORM

PROJECT DESCRIPTION: _____

_____

PROJECT LOCATION: _____
CONTRACTOR: _____

CONTRACTOR REPRESENTATIVE: _____

START DATE: _____ FINISH DATE: _____
(mm/dd/yyyy) (mm/dd/yyyy)

WORKING HOURS: _____ NO. OF WORKERS _____

SUPERVISOR IN CHARGE:_____
(PRINT)

WORK #: _____

CONTRACTOR VERIFICATION INFORMATION:
Notification Report Provided: ❑ Adequate Instruction & Training: ❑
Notice of Project: ❑ Adequate Supervision: ❑
Waste Disposal Arrangements: ❑ HEPA Integrity Testing: ❑
Workplace Safety and Insurance Board Clearance Certificate: ❑
Adequate Safe Work Practices/Abatement plan: ❑
Adequate Equipment & Personal Protective Equipment: ❑

**FOR APPROVAL** (By Chief Facilities Management)

ASBESTOS OPERATION: Low Risk ❑ Moderate Risk/Glove-bag ❑ High Risk ❑
LEAD OPERATION: Low Risk❑ Low-Moderate Risk❑ Moderate Risk❑ Moderate-High Risk ❑ High Risk❑
OTHER HAZMAT OPERATION: Project-Specific Risk Assessment❑

CONTRACTOR AWARENESS FORM COMPLETED: Yes / No

COMMENCEMENT APPROVED: _____ DATE: _____
(Signature) (mm/dd/yyyy)

COMPLETION APPROVED: _____ DATE: _____
(Signature) (mm/dd/yyyy)

UPDATE HBMP: Yes / No

# CONTRACTOR NOTIFICATION AND ACKNOWLEDGEMENT
# NOTIFICATION ET CONSENTEMENT DE L'ENTREPRENEUR

Working with asbestos can be dangerous unless appropriate work practices and personal protective equipment are utilized. Inhaling asbestos fibres can cause various types of lung disease including cancer. Smoking increases the risk of lung cancer from asbestos exposure. Correctional Service Canada has identified the presence of various friable and non-friable asbestos containing materials at:

Le travail de l'amiante présente des dangers pour la santé des travailleurs, à moins que ceux-ci utilisent des méthodes de travail et un équipement de protection individuelle appropriés, L'inhalation de fibres d'amiante peut causer diverses maladies pulmonaires. dont le cancer du poumon. Le tabagisme aggrave le risque d'être atteint d'un cancer du poumon par suite d'une exposition à l'amiante. Service correctionnel Canada a décelé la présence de divers matériaux friables et non friables contenant de l'amiante à l'endroit suivant :

| Address - Adresse |
|---|
| |

An asbestos inventory report showing the locations and amounts of these materials is available for viewing from:

On peut prendre connaissance d'un relevé indiquant les emplacements et les quantités de matériaux contenant de l'amiante auprès de :

| Name - Nom | Location - Lieu |
|---|---|
| | |

The CSC Hazardous Building Materials Management Plan applies to all maintenance and renovation work that may disturb asbestos materials. The disturbance of asbestos-containing building materials may only be undertaken by contractors who have received training in asbestos-related precautions.

Le plan de gestion des matières dangereuses de SCC s'applique à tous les travaux d'entretien ou de rénovation susceptibles d'exposer les travailleurs à des matériaux contenant de l'amiante. Seuls les entrepreneurs qui ont reçu une formation sur les précautions à prendre face à l'amiante peuvent être autorisés à entreprendre des travaux comportant une exposition à des matériaux contenant de l'amiante.

As a condition of our contract to provide services and materials to CSC, this company will not disturb asbestos-containing materials without prior notification to:

Aux termes du contrat de fourniture de services et de matériaux conclu entre SCC et l'entreprise soussignée, cette dernière s'est engagée à ne pas entreprendre de travaux entraînant une expositon à l'amiante sans en informer d'abord :

| Name - Nom |
|---|
| |

This firm and the employees of this firm will follow all procedures as specified by the CSC Hazardous Building Materials Management Plan, while working in:

L'entreprise et son personnel sont tenus de respecter toutes les procédures prescrites par Plan de gestion des matières dangereuses de SCC, pendant toute la durée des travaux effectués à l'endroit suivant :

| Address - Adresse |
|---|
| |

| Company name - Nom de la compagnie | |
|---|---|
| Name - Nom | Title - Titre |
| Signature | Date |