




Public Services and Procurement Canada

Requisition No. EZ899-220723/A


DRAWINGS & SPECIFICATIONS
For
Project No.: R.105676.001
Penticton Air Terminal Building Roofing & Building Envelope Project

APPROVED BY:


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Discipline

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Coordinating Professional and Envelope Seal



2021-07-15
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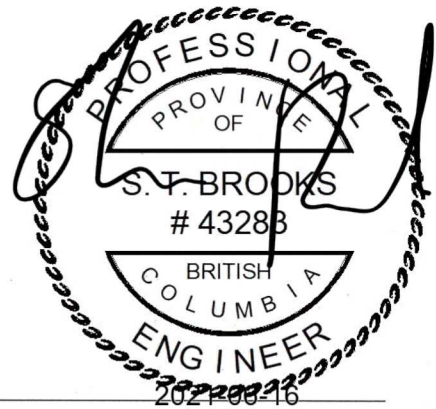
Seal / Signature / Date

Mechanical



June 16, 2021

Electrical



2021-08-16

CONSULTANTS – SEAL & SIGNATURE

Discipline

Seal/Signature/Date

Structural



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Part 1 General

The drawings listed below will be included in the General Contractor/PWGSC agreement and will become part of the contract.

Drawing No.	Drawing Title	Date
R-0.0	Cover Page and Site Plan	July 14, 2021
R-1.0	General Notes	July 14, 2021
R-2.0	Main Floor Plan	July 14, 2021
R-2.1	Roof Plan	July 14, 2021
R-3.0	Building Elevations	July 14, 2021
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R-4.4	Skylight and Roof Details	July 14, 2021
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R-4.6	Door Details	July 14, 2021
R-4.7	Window Fin Details	July 14, 2021
R-5.0	Glazing Schedule	July 14, 2021
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S4.01	Existing Roof Upgrade Plan & Sections	July 14, 2021
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M601	Mechanical Equipment Schedules	July 14, 2021
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END OF SECTION

Part 1 General

1.1 DESCRIPTION OF WORK

- .1 See 01 11 00 – Summary of Work

1.2 WORK SEQUENCE

- .1 See 01 11 00 – Summary of Work

1.3 SCHEDULE

- .1 The tender submission must be complete with an outline bar chart showing the total duration, in calendar weeks, of the glass and aluminum curtain wall system installation. The bar chart as a minimum must define the duration for each of the following:
 - .1 Engineering design
 - .2 Shop drawing preparation
 - .3 Tool and die manufacturing
 - .4 Glass delivery
 - .5 Design approval (Authorities, architect, conformance testing)
 - .6 Site Mock-ups and Site Performance Testing and approval
 - .7 Curtain wall installation
- .2 In conjunction with and in a form acceptable to the Departmental Representative, provide within five (5) working days after contract award, a schedule indicating the phasing and procedures required to complete the Work within the submitted timeframe.
- .3 The construction schedule shall reflect completion of all work under the Contract within the specified time and in accordance with these specifications.
- .4 The Contractor shall submit a revised schedule to the Departmental Representative if, after commencing the Work, the schedule fails to reflect actual progress or the Contractor wishes to make a major change to their approach. The revised construction schedule must be submitted in advance of beginning a revised approach.
- .5 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
- .6 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.

1.4 CONTRACTOR'S USE OF SITE

- .1 Refer to 01 11 01 – Use of Site.

1.5 TEMPORARY LIGHTING AND UTILITIES

- .1 Provide and maintain temporary lighting as required for safe demolition and working conditions per British Columbia Occupational Health and Safety Regulations.
- .2 Provide motion-activated lights on swing stage or scaffold as a security measure when the Contractor is not on site. Ensure that no loose debris is left near the motion sensor.
- .3 Installation and Removal:
 - .1 Provide temporary utilities controls in order to execute work expeditiously.
 - .2 Remove from site all such work after use.

1.6 TEMPORARY FIELD OFFICES AND SHEDS

- .1 Provide or construct work sheds for storage of tools, equipment and materials, which may be damaged by weather.
- .2 Provide and maintain a field office for the Contractor's personnel that is equipped with lights, power, and tables for drawing examinations.
- .3 Maintain sheds in a clean and orderly condition to the Departmental Representative's satisfaction.
- .4 Provide suitable hardware and locks on doors to sheds to reasonably secure them and keep locked when unsupervised.
- .5 Field sheds shall be weather tight and have floors elevated above grade.
- .6 Relocate sheds as required by the progress of the Work. Remove sheds from the Site when directed or when they are no longer required.
- .7 Contractor to provide own power source as needed for temporary field offices and sheds.
- .8 Provide office of size to accommodate site meetings and Contractor's operations.
- .9 Provide a clearly marked and fully stocked first-aid case in a readily available location.

1.7 TEMPORARY HEATING AND VENTILATION

- .1 Provide and maintain supplementary heating as required to maintain sufficient application and curing temperatures.
- .2 Provide and maintain supplementary ventilation as required. Ventilation requirements shall conform to British Columbia Occupational Health and Safety Regulations. Do not modify the base building systems without the coordination and approval of the Departmental Representative.
- .3 Temporary heating and ventilation used during construction -- including the cost of installation, fuel, operation, maintenance and removal of equipment -- shall be paid

for by the Contractor. The use of direct-fired heaters discharging waste products into enclosed work areas will not be permitted.

1.8 ELECTRICAL POWER

- .1 Contractor to provide electrical power for duration of work.
- .2 The Contractor shall pay for any alternations to the electrical system which may be needed to accommodate the Contractor's equipment. Co-ordinate any required alterations with the Departmental Representative. Reinstate the system to its original condition upon completion of the Work.

1.9 WATER SUPPLY

- .1 Contractor to provide water supply for the duration of work.
- .2 The Contractor shall pay for the cost of any temporary water connections or alterations that are required to perform the Work. Reinstate the system to its original condition upon completion of the Work.

1.10 SANITARY FACILITIES

- .1 Contractor to provide portable washrooms at the time of initial mobilization and maintain throughout the course of work. Locate in area where odour would not be a concern to the airport. Contractor to confirm the location with the Departmental Representative.

1.11 TRAFFIC CONTROL AND SIGNAGE

- .1 Provide all required signage necessary to protect the public from the construction and work area, control pedestrian and/or vehicular traffic flow, and to inform users that construction activity is in progress. Signage is to be of a professional quality to the Departmental Representative's satisfaction.
- .2 Signage may only be safety-related and may not be advertising or company signs.
- .3 The Contractor is to provide flagmen and/ or traffic control lights as necessary to maintain safe traffic flow through the work areas.

1.12 LOCATION OF EXISTING UTILITIES AND EQUIPMENT

- .1 The Contractor shall be responsible for arranging for the location of all existing utilities prior to construction and protection of it during construction.
- .2 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .3 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.
- .4 Inform Departmental Representative of impending installation and obtain approval for actual location.

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

1.13 WORK SITE SAFETY – CONTRACTOR IS “PRIME CONTRACTOR”

- .1 The Contractor shall, for the purposes of the British Columbia Occupational Health and Safety Regulations, and for the duration of the Work and Contract:
 - .1 Be designated as “Prime Contractor” pertaining to safety at the “Work site”.
 - .2 Do everything that is reasonably practicable to establish and maintain a system or process that will ensure compliance with the Act and its regulations, as required to ensure the health and safety of all persons at the “Work site”.
- .2 The Contractor shall direct all subcontractors, workers and any other persons at the “Work site” on safety related matters, to the extent required to fulfill its “Prime Contractor” responsibilities pursuant to the Act.

1.14 MATERIAL AND EQUIPMENT

- .1 Unless otherwise specified, Contractor shall provide, maintain and pay for all materials, tools, machinery, equipment, temporary facilities, controls and conveniences necessary for execution of the Work. All materials shall be new, of merchantable quality, and suitable for the intended purpose.
- .2 Unless otherwise specified, comply with Manufacturer’s latest printed instructions for materials and installation methods. Notify the Departmental Representative in writing of any conflict between the Contract Documents and Manufacturer’s instructions. Deliver, store and maintain packaged materials with Manufacturer’s seals and labels intact.

1.15 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.
- .3 Specified in Section 01 91 41 Commissioning Training.

1.16 GENERAL COMISSIONING

- .1 Specified in Section 01 91 13 General Commissioning Requirements.
- .2 Commission installed systems prior to Demonstration and Training.

1.17 RENOVATIONS

- .1 The contract documents are based on assumed as-built dimensions for the existing building structure and assumptions in accordance with detailing and placing practice. These assumptions may vary from the actual on-site conditions. The

- Contractor shall immediately inform the Departmental Representative of any actual variations from the assumed conditions.
- .2 Minor modifications will be required to the work indicated on the drawings to reflect actual site conditions. The contractor will cooperate with the Departmental Representative in this regard. Minor modifications will become the responsibility of the Contractor and will not result in a change in the contract price.
 - .3 Ensure that all necessary job dimensions are taken and all trades are coordinated for the proper execution of the work. The Contractor shall assume complete responsibility for the accuracy and completeness of such dimensions, and for coordination.
 - .4 Prior to fabrication of any structural members, the Contractor shall complete this site review of critical "tie-in" dimensions and confirm all dimensions to ensure proper fit of new work to existing. Report any discrepancies to the Departmental Representative prior to starting work.
 - .5 Commencement of construction or any part thereof constitutes acceptance of existing conditions and means dimensions and elevations have been considered, verified and are acceptable.
 - .6 Any openings that are not shown or indicated on the structural drawings shall be reported to the Departmental Representative for review. These openings may not be allowed, may have to be moved, or may require additional structural work and detailing. Do not proceed with these openings without written permission from the departmental representative.
 - .7 Unless noted otherwise on the structural drawings, the coring or cutting of openings and holes shown on the structural drawings through the existing structure shall not cut any reinforcing bars. The contractor shall locate the position of existing reinforcing bars in the vicinity of the holes and sleeves to be cut or cored, and the holes and sleeves shall be located to avoid cutting of reinforcing bars. Where this is not possible, it shall be reported to the Departmental Representative for review.
 - .8 New openings to be cut through existing floor slab or walls shall be clearly marked out by the Contractor. The Contractor shall notify the Departmental Representative once the marking out has been completed so that the Departmental Representative can review the proposed locations of all new openings. Do not proceed with cutting of new openings without the approval of the Departmental Representative.
 - .9 Unless noted otherwise on the drawings new straight sided openings through existing slabs and walls shall be sawcut with no overcuts. Use cored holes at the corners. Jackhammering shall not be permitted. Refer to the details and procedures indicated on the structural drawings for the new openings. Alternates to the above procedures must be reviewed by the Departmental Representative prior to the start of demolition or construction.

- .10 Contractor to ensure that underground or in-slab services are not damaged through demolition, sawcutting, hole auguring, or other construction activities. See specification for testing/locating requirements.
- .11 The Contractor is responsible for safety in and about the job site during construction, and the design and erection of all temporary structures, formwork, falsework, shoring, bracing, etc., required to complete the work (submit shoring drawings sealed by a Specialty Structural Engineer).
- .12 Drill and site measure bolt holes in existing structure prior to fabricating steel connection plates. Bolt holes may have to be moved from what is shown on the drawings to avoid cutting existing reinforcing or to avoid other site conditions. Site modification of steel connection plates will not be accepted without the prior approval of the Departmental Representative.

1.18 COORDINATION

- .1 The Contractor is responsible for coordination of trades. Lines of demarcation between Contractor's work and trades' work are solely the responsibility of the Contractor. The Departmental Representative assumes no responsibility for division of the Work or for any jurisdiction regarding such division.
- .2 Contractor is responsible for coordination with the Departmental Representative of all on-site activity as it affects the operation of the building.
- .3 The Contractor is to notify the Departmental Representative at least 24 hours in advance for site review. No work shall be covered or concealed until the Departmental Representative has reviewed it, unless they have informed the Contractor that a site review will not be performed. Such review does not absolve the Contractor from their responsibility to perform the Work in accordance with the contract documents.

1.19 SUPERINTENDENCE

- .1 The Contractor shall provide a full time on-site Superintendent that is responsible for the quality, control, organization, and coordination of all phases of the Work. The Superintendent shall be in attendance at all site meetings.
- .2 Superintendence shall be satisfactory to the Departmental Representative.
- .3 Superintendence shall be deemed unsatisfactory and changes or additions to superintendence can be demanded by the Departmental Representative when control, organization, or coordination of the Work is not adequate, the quality of the Work does not meet the Contract Document requirements, directions given in accordance with the Contract Documents are not followed, or progress is behind schedule.

1.20 ADMINISTRATION OF PROJECT MEETINGS

- .1 A representative of the Contractor shall record the minutes, include significant proceedings and decisions, and identify "action by" parties. Refer to Section 1.19 for the administration of the Pre-Construction Meeting.

- .2 The Contractor shall reproduce and distribute copies of minutes to meeting participants and to affected parties not in attendance within 3 business days.
- .3 The Contractor shall schedule and administer project meetings.
 - .1 Prepare agenda for meetings.
 - .2 Distribute written notice of each unscheduled meeting three (3) days in advance of meeting date to Departmental Representative, and relevant Subcontractors.
- .4 The meetings will take place in Transport Canada's site boardroom in the Air Terminal Building. Meeting may take place over teleconference due to COVID-19.
- .5 Representatives of Contractor, Subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the party each represents.

1.21 PRE-CONSTRUCTION MEETING

- .1 After award of Contract, a meeting of all parties in the Contract shall be held to discuss and resolve administrative procedures and responsibilities.
- .2 Representatives of the Departmental Representative, Contractor, major Subcontractors, and construction review personnel will attend.
- .3 The Departmental Representative shall establish a time and location of the meeting and shall notify concerned parties at least five (5) days before the meeting.
- .4 The Departmental Representative will take the minutes and distribute.
- .5 Agenda to include the following:
 - .1 Appointment of official representatives of participants of the Work.
 - .2 Schedule of Work, progress scheduling.
 - .3 Shop drawings (if required) and schedule of shop drawing submissions.
 - .4 Requirements of temporary facilities, site signage, hoarding, dust protection, offices, storage sheds, utilities, fences.
 - .5 Delivery schedule of critical equipment.
 - .6 Site security.
 - .7 Contemplated change orders, procedures, approvals required.
 - .8 Take over procedures, acceptance, warranties.
 - .9 Monthly progress claims, administrative procedures, holdbacks.
 - .10 Appointment of inspection and testing agencies or firms.
 - .11 Insurance, transcript of policies.
 - .12 Line of Communication
 - .13 Site Orientation

- .14 Health and Safety
- .15 Quality of Work
- .16 Permits/Notices

1.22 PROGRESS MEETING

- .1 During course of Work the Contractor shall schedule progress meetings every two weeks. Further progress meetings may be scheduled by the Contractor or Departmental Representative as required to expedite the Work.
- .2 The Departmental Representative, Contractor, major Subcontractors involved in the Work are to be in attendance.
- .3 The **CONTRACTOR** shall notify parties minimum three (3) days prior to scheduled meetings of any changes to time or place.
- .4 **Agenda to include the following:**
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems which impede construction schedule, conflicts.
 - .4 Progress, schedule, during succeeding work period.
 - .5 Corrective measures and procedures to regain projected schedule.
 - .6 Revisions to construction schedule.
 - .7 Review of off-site fabrication delivery schedules.
 - .8 Review submittal schedules; expedite as required.
 - .9 Maintenance of quality standards.
 - .10 Pending changes and substitutions, Notices of Proposed Change, Change Orders.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

Part 2 Products

Not applicable.

Part 3 Execution

Not applicable.

END OF SECTION

Part 1 General

Work under this Contract includes the building envelope renewal of the Air Terminal Building of the Penticton Regional Airport, in the City of Penticton, in the Province of British Columbia.

1.0 DESCRIPTION OF EXISTING STRUCTURE

.1 The Penticton Regional Airport consists of one above-grade storey. It contains one passenger departure gate, a luggage claim area, ticket and service desks, a food area, and a suite of offices and service rooms at the south end of the building. Building construction was circa 1963. The structural system is a one-storey wood frame building. The walls are stud framed, and the roof has trusses on posts for large span areas, and joists on stud framing for shorter spans.

1.1 DESCRIPTION OF WORK

It is the Contractors responsibility to provide all labour, material, equipment and supervision to complete the repairs outlined in this specification taking into account all site conditions, noise restriction, work area restrictions, protection requirements, accessibility restrictions, etc. No extras will be entertained for inconveniences after the award of this Contract.

In particular the work includes, but is not necessarily limited to the following:

- .1 Envelope and Structural:
1. The installation and maintenance of hoarding, dust protection and construction signage around each phase of the work as described in Section 01 56 00 – Temporary Barriers and Enclosures.
 2. Upgrades to the exterior wall system in areas designated on the drawings. Upgrades include removing the existing cladding, building paper, any exterior insulation, soffit and fascia and installing a new air vapour barrier, exterior insulation, strapping, cladding, soffit and fascia.
 3. Tie-ins to existing wall and roof systems that are to remain.
 4. Upgrades to the roof system in areas designated on the drawings. Upgrades include removing the existing roofing system down to the sheathing and installing a new air vapour membrane, exterior insulation, cover board and 2-ply modified bitumen membrane.
 5. Remove all existing roof sheathing and sloped/tapered joists for structural diaphragm upgrade.
 6. Replacement of roof flashing at locations of roof penetrations, curbs, parapets, etc.
 7. Replacement of existing windows in areas designated on the drawing with new triple glazed aluminium windows.

8. Replacement of existing doors in areas designated in drawings with new triple glazed door systems. Doors to allow for future implementation of security access system. Reuse existing security system where indicated.
 9. Replacement of existing skylight and clerestory window systems in areas designated on the drawings with new systems.
 10. Installation of new gated entry system for the Flight Service Station.
- .2 Mechanical:
1. Demolition and removal of existing rooftop mounted Air Conditioning Units; ACU-2, ACU-4, ACU-5.
 2. The installation of three new rooftop mounted Air Handling Units; AHU-2, AHU-4, AHU-5.
 3. Demolition and removal of two existing rooftop mounted utility style supply air fans; SAF-1, SAF-2.
 4. The installation of two new utility style supply air fans; SF-1, SF-2.
 5. Demolition and removal of two existing rooftop mounted exhaust fans; EF-1, EF-3.
 6. The installation of two new exhaust fans; EF-1, EF-3.
 7. Modification of existing mechanical services (duct, gas pipe, controls) to accommodate the renovation work.
 8. Modification of existing roofing membrane, roof structure and roof curbs to accommodate the new roof top mounted HVAC equipment.
 9. Modification of existing electrical services to accommodate the renovation work.
 10. Modification of existing HVAC controls to accommodate the renovation work.
 11. Modification of existing ceilings to accommodate the renovation work. Remove and reinstate ceiling tiles, and patch drywall ceilings as required to access equipment.
- .3 Repair all areas damaged by construction activity; specifically, the Contractor shall repair all damage resulting from the Construction to the satisfaction of the Departmental Representative including repainting of surfaces in accordance with these Specifications which have been damaged.
- .4 Final cleaning of structure, fixtures, piping, etc., and the disposal all waste products and/or debris generated by the construction activity as well as any material present in the work area prior to the commencement of the Work. The areas requiring cleaning shall consist of all areas affected by the Work.

1.2 WORK SEQUENCE

- .1 Work on the “secure air-side” portion of the building is to be coordinated with the Departmental Representative. The Departmental Representative shall supply the current airline flight schedule for scheduling purposes.
- .2 Contractor to begin work upon award of the contract. Contractor to confirm start date. All work outlined in these specifications are to be completed within 6 months of award of contract.
- .3 Time and all time limits stated within the Bid submittal and Contract Documents are of the essence of the Contract. Contractor shall perform work expeditiously with adequate forces to complete the Contract Work within the time specified.
- .4 Schedule the replacement of mechanical units to minimize the time period when affected zone (s) are without full HVAC services. Coordinate work schedule with the Departmental Representative. Insure just-in-time delivery of new units and associated equipment on-site, as well as completion of all connections and utilities required to allow installation to start as soon as the existing unit is removed. Note that on-site storage of equipment will be restricted.

1.3 PHASING OF THE WORK

- .1 In order to successfully complete the proposed repairs while minimizing the disruption to any Airport operations, the work must be phased and each area of work must be completely enclosed to accommodate the repairs and protect the Airport staff and users from inconvenience and injury. Staging/phasing is required in order to maintain all airport operations and accesses. Works impeding operations or accesses may need to be completed outside of work hours. Contractor to confirm with Departmental Representative.
- .2 To minimize the impact to the air terminal building (ATB) operation, phase the replacement schedule of each roof-top air handling unit, and provide temporary cooling and ventilation as follows:
 - .1 AHU-02 and AHU-05 replacement shall be performed and completed during non-office hours.
 - .2 For AHU-04, provide 24 hours per day, 7 days per week temporary ventilation with cooling capacity of 3 tons for the full duration of system shutdown.
- .3 Prior to commencing with the demolition of any of the existing roof-top HVAC units, ensure that all power, controls, and gas pipes for the new HVAC units are in place, and that the new replacement unit is on-site and ready to be craned in place.

1.4 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.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 CONTRACTORS USE OF SITE

- .1 The building is to remain open throughout the course of the Work. The Contractor shall have use and access to the designated work areas, unless otherwise stipulated by the Departmental Representative during the course of the Work.
- .2 The Contractor shall co-ordinate their work schedule with the Departmental Representative so as to minimize disruptions of the site. No work shall be performed until approved by Departmental Representative.
- .3 The use of all equipment is to be restricted in accordance with noise by-laws. Contractor has access to the work areas with quiet work proceeding around the clock if desired.
- .4 All noise-generating and vibration-generating works that could impact airport operations are to be reviewed with the Departmental Representative and proposed hours approved prior to beginning them. These works may need to be complete after hours or between flights, as disruptive works during peak times may interfere with critical airport operations.
- .5 As required for phased construction and craning arrange in advance with Departmental Representative if specific working hours are to be adhered to.
- .6 It is the Contractor's responsibility to ensure the building remains operational at all times and to perform work as required to ensure that access to exits and entrances are available to the building users at all times.
- .7 The Contractor has 24-hour access to site; however, the use of the premises will be restricted due to user occupancy and security reasons.
- .8 Contractor must coordinate access to NAV CANADA areas and Customs Offices with the Departmental Representative. Areas are designated on the floor plan.
- .9 The Contractor shall schedule their operation to minimize the interruption of the normal use of the site and building and to comply with laws, ordinances, rules and regulations relating to Work.
- .10 The Contractor is to provide the Departmental Representative with a schedule that lists all parking spaces to be occupied or restricted at least five (5) working days prior to occupying or restricting those spaces. Parking spaces are limited at the airport, so only essential crew trucks are permitted on-site.
- .11 It is the Contractor's responsibility to control traffic and to redirect if necessary to allow access to building areas outside of the work area. Any required traffic rerouting and the work sequence shall be closely co-ordinated with the Departmental Representative.

- .12 Provide signage of professional quality, barriers and hoarding necessary to protect the public from construction and Contractor operations, to secure the work area, and to route traffic through or around the work areas as designated. Signage indicating that repairs are being performed and we are sorry for the inconvenience must be provided at each entrance. These signage requirements are in addition to any standard signs required to control and/or reroute traffic or maintain public safety. Refer to 01 56 00 – Temporary Barriers and Enclosures and 01 32 19 – Security.
- .13 Hoarding and dust protection is to be provided around each area of work in accordance with specification Section 01 56 00 – Temporary Barriers and Enclosures. Each phase of the work is to be sealed to prevent the release of construction dust into other areas.
- .14 Contractor shall implement temporary measures to maintain interior air quality, temperature, and ventilation during performance of the Work.
- .15 The use of all power plant and percussive equipment is to be in accordance with all local by-laws and ordinances.
- .16 Do not unreasonably encumber the Place of Work with materials or equipment. Construction related debris shall not be permitted to accumulate on site where visible to building users. Remove daily if necessary.
- .17 Do not overload the structure.
- .18 Do not overload slab areas with equipment or stored materials. Review all equipment weights and loading procedures with Departmental Representative prior to commencing work.
- .19 Do not close or obstruct or store materials in roadways, sidewalks or passageways without prior approval from the Departmental Representative. Do not interfere with safe passage to and from the building and adjacent public sidewalks and roads. Move stored products or equipment that interferes with building operations.
- .20 Take all precautions and provide all required protection to ensure the safety of the general public.
- .21 No storage of materials or equipment is allowed outside the designated work areas without the Departmental Representative's approval.
- .22 During transportation of materials or equipment through occupied areas, ensure the public, property, and finishes are protected from damage. All damage caused by the Contractor is to be repaired or rectified at the Contractor's expense.
- .23 The Departmental Representative is to complete and submit the application for the building permit. The Contractor is to pick up and pay for the building permit upon award of contract. Contractor to obtain and pay for all other permits required for completion of the Work. Do not start construction until the Building Permit has

- been issued. Provide copies of all other permits to the Departmental Representative and post on site where required.
- .24 Arrange all construction access into occupied areas with the Departmental Representative to allow the Departmental Representative to provide proper notice, where required.
 - .25 Maintain work areas and the vicinity clean and tidy to the satisfaction of the Departmental Representative.
 - .26 Protect all existing light standards, walls, plants, finishes, windows, doors, etc.
 - .27 Protect all utilities, gas mains, electrical conduit, etc. that must remain in service throughout the construction period.
 - .28 During transportation of materials or equipment through occupied areas, ensure the public, property, and finishes are protected from damage. All damage caused by the Contractor is to be repaired or rectified at the Contractor's expense.
 - .29 The Contractor shall make allowance in their price to cover all costs of temporary removal and replacement and/or relocation of existing electrical wiring and mechanical hardware required for completion of the work.
 - .30 Propane powered equipment is not permitted within interior areas.
 - .31 Temporary heat and ventilation used during construction -- including the cost of installation, fuel, operation, maintenance and removal of equipment -- shall be paid for by the Contractor. The use of direct-fire heaters discharging waste products into work areas will not be permitted.
 - .32 The Contractor is required to use Airport Road for delivery and removal of material for duration of the project. Contractor to manage and store all required materials and bins within work areas. Contractor should limit the encumbrance on the airport site from the materials. Contractor to be responsible for all required permits.
 - .33 Maintain free access routes for ambulance, fire emergency vehicles, garbage trucks, etc.
 - .34 Contractor to provide safe access to execute the work specified in the contract documents. Access may be comprised of: scaffolding, staging, swing stages, false work, combinations of the proceeding or other methods approved by WorkSafe BC.
 - .35 All access shall be suitable for the safe and efficient performance of the work. Contractor to submit a plan of the building (provided) indicating the type of access to be employed on each portion of the building. Phasing of access is acceptable.
 - .36 All access shall be capable of resisting its dead load and the live load of the workers and stored materials. Live loading to conform to CAN/CSA S269.2 M87, access scaffold for construction purposes, Clause 5.2.1.(b).

- .37 All staging/phasing is required in order to maintain all airport operations and accesses. Works impeding operations or accesses may need to be completed after-hours.
- .38 Reference: British Columbia Occupational Health and Safety Regulation (Regulation 296/97) Part 13.
- .39 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .40 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities

1.2 CRANE USE

- .1 Maximum crane operational height is 12 meters (40 feet).
- .2 Contractor shall be familiar with and follow airport safety and security procedures and restrictions for all work performed outdoors in the immediate perimeter and on the roof of the Penticton airport – air terminal building. The airport shall remain operational throughout the duration of the renovation.
- .3 Contractor shall work within the allowable time determined by the Departmental Representative.
- .4 The crane may be setup on the land and/or air side. Provide all crane support, safety systems, and personnel for complete operation as required for the scope of work herein.
- .5 Contractor shall provide a crane operation schedule indicating when each roof mounted ACU is to be removed and the replacement ACU installed. Coordinate the crane operation schedule with the temporary HVAC provisions. At minimum, the schedule shall indicate:
 - 1. Date of hoisting.
 - 2. Duration (length of time) of crane in raised position. ACU-#: To be removed and/or replaced.
 - 3. Location of crane: air side or land side.
- .6 Modify the crane operation schedule and crane setup as require to suit the site conditions without extra cost to the Departmental Representative.

1.3 EFFECT ON BUILDING AND SITE

- .1 The Contractor shall schedule their operations to minimize the interruption of the normal use of the site and building and to comply with laws, by-laws, ordinances, rules and regulations relating to the Work.
- .2 The Contractor shall be responsible for arranging for the location of all existing utilities prior to construction and protection of the same during construction.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 13 – Special Procedures for Airport Facilities
- .2 Appendix A – Plan of Construction Operations

1.2 SECURITY

- .1 Refer to section 01 32 19 – Security

1.3 WORK AFFECTING NAV CANADA

- .1 Works required to be inside the NAV CANADA equipment room, Departmental Representative and TC must coordinate Work with NAV CANADA Local Operations and Technical Operations to ensure no impact and/or interruption to their equipment.
 - .1 Contractor to coordinate access with the Departmental Representative.
 - .2 Power outages to Flight Services Station (FSS) must be coordinated minimum 2 weeks in advance with Paul England, Shawn Liddicoat and the Vancouver FIR Technical Operations Coordination Centre.
 - .3 The HWOS wireless link must remain un-obstructed.
 - .4 Line-of-sight to the runway and maneuvering areas must remain unobstructed.

1.4 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.
- .2 For all public areas, provide for access by pedestrian and vehicular traffic on and around site where work is in progress.

1.5 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Contractor to provide sanitary facilities. Keep facilities clean.

1.6 SERVICE INTERRUPTIONS:

- .1 Refer also to Appendix A - Plan of Construction Operations.
- .2 Notify Departmental Representative of intended interruption of power, communication and water services and provide schedule of interruption times.
- .3 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.
- .4 Contractor must submit a detailed work plan clearly indicating system or building loads affected during the proposed shutdown and provide appropriate measures to mitigate system or service disruptions. The Airport manager may cancel the planned service interruption within 24 hours prior to the scheduled work.

1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to public, occupants, building operations and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.8 EXISTING SERVICES

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative a minimum of 5 working days notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for personnel and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00- Temporary Barriers and Enclosures.

1.9 SPECIAL REQUIREMENTS

- .1 Coordinate scheduling requirements for all noise generating Work with the Departmental Representative
- .2 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.
- .4 Deliver materials to the site Monday to Friday between 08:00 to 16:00 hours unless otherwise approved by Departmental Representative.

- .5 Materials storage on site is limited. Arrange storage locations with Departmental Representative prior to materials delivery. Refer to Section 1.31 of 01 11 01 – Use of Site.
- .6 Any actions involving equipment containing halocarbons must be followed to ensure compliance with the Federal Halocarbon Regulations. This includes:
 - .1 All work involving halocarbon containing equipment must be conducted by a certified technician.
 - .2 A record of the work conducted must be provided by the technician and the service log updated.

The above would apply to any AHUs that need to be temporarily decommissioned and lifted to allow roofing/rehabilitation works to be completed.

1.10 BUILDING SMOKING ENVIRONMENT

- .1 Smoking is not permitted inside any buildings. Comply with smoking restrictions for smoking outside the ATB.

1.11 AIRPORT OPERATION AND SECURITY

- .1 Refer also to Appendix A.
- .2 Access to any portions of the roof or the presence of tall equipment (such as cranes and hoists) that may affect airport operations must be coordinated with the Departmental Representative, and approved ahead of such work being performed. Approval for tall equipment, such as cranes and hoists, requires a thirty (30) day notice with with proposed lift details (including equipment, proposed dates & times, durations, areas of impact, etc.).

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Secure air-side: Roof and exterior portions of the building beyond the airport's secure perimeter fencing.

1.2 RESTRICTED OF SECURE AREA

- .1 For work on secure air-side of building, refer to Appendix A – Plan of Construction Operations.
- .2 All airport security will remain in effect throughout the construction project. All of the Contractor's staff will be required to adhere to security procedures as identified by the Penticton Airport Manager or delegate. The Penticton Airport Manager is to be supplied with a list of all the Contractor's personnel and vehicles to be working on secure air-side.
- .3 Any area on airport property to which access is restricted by sign and/or monitored is a secure or restricted area.
- .4 In general, access to the secure air-side of the Airport is restricted to the access points approved by Airport Manager. All personnel and vehicles entering or leaving the construction site must follow prescribed access routes and be under escort or surveillance.
- .5 Security measures shall be taken at Contractor's expense to meet the Airport's security requirements.
- .6 Transport Canada may, for security reasons, remove all of Contractor's workforce from Airport at any time. No assessment for temporary "Stop Work" periods will be payable by Transport Canada.

1.3 CONTRACTOR'S RESPONSIBILITY

- .1 General Contractor and subcontractor shall be responsible for construction, personnel and vehicles employed on project and requiring access to restricted areas.
- .2 All Contractor personnel and equipment must remain within designated work areas at all times.
- .3 Contractors shall be responsible for security of their own equipment and materials.

1.4 ASSES AND KEYS

- .1 Passes are mandatory on secure air-side of airport perimeter fencing and other restricted areas for all personnel engaged in work and are subject to airport restricted area access clearance.
- .2 Passes for personnel requiring access to restricted area will be made available on application to the Airport Manager.
- .3 Permanent passholders — Commissionaires shall provide escort and surveillance to temporary passholders.

- .4 Temporary passes will be issued at beginning and returned at end of each working day. Their safekeeping will be responsibility of Contractor.
- .5 On completion of project, passes will be returned to Airport Manager. A charge of \$500.00 will be issued for each pass not returned.

1.5 RESPONSIBLE PERSONNEL

- .1 Provide the Departmental Representative and the Airport Manager with a list of responsible personnel and phone numbers, and those of subcontractors, who may be contacted after working hours in case of emergency.

1.6 EXISTING SECURITY BARRIERS

- .1 Security barriers, such as doors, fences, gates, locks, or door hardware, which are required to be removed, must be replaced, if practicable, at the end of each work day. If it is necessary to remove barriers for an extended period, enclose unprotected areas with temporary secure hoarding. Where the possibility exists that the restricted area may be left unprotected at the end of the work day, inform Airport Manager immediately.
- .2 Failure to restore such security barriers when required will result in their restoration by other forces and the cost of such restoration being recovered from the Contractor.

1.7 DAILY SECURITY

- .1 Ensure that access to the restricted area is secured at the end of each work day.
- .2 When work is to be done within the restricted area after scheduled working hours, notify the Airport Manager of area and times.
- .3 The Contractor shall follow the Airport Manager's instructions to maintain airport security during all phases of construction. Any work required to restore airport security will be carried out at the Contractor's expense.

1.8 COMMISSIONAIRES

- .1 Security escort is required when accessing secure air-side/restricted locations including outdoor areas within the airport security/apron fencing. The Contractor's personnel must be within direct line of sight of the security escort at all times, unless within approved construction zone boundaries/fencing.
- .2 Security escort shall be provided by Commissionaires BC.
- .3 Contractor shall set up direct contract with Commissionaires BC. Contractor is responsible for costs of all security escorts throughout the project.
- .4 The contractor shall book Commissionaires directly with Commissionaires BC. Book as many Commissionaires as required to satisfy the requirements of .1 above. Notify the Departmental Representative of all bookings and cancellations for information purposes.

- .5 Book Commissionaires in advance as much as possible. A minimum callout of 4 hours is required. Any cancellations shall be made 24 hours in advance.
- .6 Commissionaires BC website: <http://comissionaires.bc.ca>.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

- .1 This section specifies general requirements and procedures for Contractor shop drawing, product data, sample, and mock-up submissions for the Departmental Representative's review. Additional specific submission requirements may be specified in other specification sections.
- .2 Submit to Departmental Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .3 Do not proceed with work until relevant submissions are reviewed by Departmental Representative.
- .4 Present shop drawings, product data, samples and mock-ups in imperial units. Where items or information is not produced in imperial, converted values are acceptable.
- .5 Contractor's responsibility for errors or omissions in any submission is not relieved by Departmental Representative's review of the submission.
- .6 Notify Departmental Representative, in writing at time of submission, of any deviations from the requirements of Contract Documents that form part of submissions. Also indicate the reasons for the deviations.
- .7 Contractor's responsibility for deviations from the requirements of the Contract Documents in submissions is not relieved by Departmental Representative's review of the submissions unless Departmental Representative provides written acceptance of the identified deviations.
- .8 Make any changes in submissions that Departmental Representative may require consistent with the Contract Documents and resubmit where directed by Departmental Representative.
- .9 Notify Departmental Representative in writing of any revision other than those requested by Departmental Representative when resubmitting.
- .10 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .11 Where items or information is not produced in SI Metric units converted values are acceptable.
- .12 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
- .13 Verify field measurements and affected adjacent Work are coordinated.
- .14 Keep one reviewed copy of each submission on site.

- .15 Maintain a submittal log.

1.1 SUBMISSION REQUIREMENTS

- .1 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.
- .2 Submit electronic copies of product data, manufacture's catalogue sheets, brochures, literature, performance charts and diagrams.
- .3 Comply with the following requirements in regard to submission of product data:
 - .1 Delete information not applicable to project.
 - .2 Supplement standard information to provide details applicable to project.
 - .3 Provide certification of compliance to applicable codes.
 - .4 Provide manufacture's certification as to current production.
- .4 Allow fifteen (15) working days for Departmental Representative's review of each submission.
- .5 Accompany submissions with an electronic transmittal letter that contains:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .6 Submission shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions and clearances.

- .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .6 After Departmental Representative's review, distribute electronic copies to relevant affected subcontractors.

1.2 SHOP DRAWINGS

- .1 Provide electronic copies of shop drawings pertaining to installations and fabrications required by the Contract for the Departmental Representative's review prior to commencing work. Full-size hard copy submissions are also to be provided if requested by the Departmental Representative. In addition to the shop drawing submissions mentioned in each specification section and unless noted otherwise, shop drawings shall be submitted for the following work:
- .1 Temporary shoring and bracing.
 - .2 All window and door systems.
 - .3 Cladding
 - .4 Subsequent shop drawings noted in specification sections.
- .2 Submit one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product. Notwithstanding the foregoing, submit full shop drawings including but not limited to the following items: toilet partitions, washroom accessories (provide layout drawing), detention and commercial doors and frames, detention windows, and chain link fencing.
- .3 As part of the Departmental Representative's field services, Departmental Representative will review shop drawings pertaining to work shown on Departmental Representative's drawings by means of an appropriate rational sampling procedure and will comment on the accuracy with which the Contractor prepared the shop drawings.
- .4 Review of shop drawings is for the sole purpose of ascertaining conformance with the general design concept and is not an approval of the detail design inherent in the shop drawings. The design responsibility shall remain with the Contractor submitting the shop drawings.

- .5 Review of shop drawings shall not relieve the Contractor of their responsibility for errors and omissions in the shop drawings or for meeting all requirements of the Contract Documents.
- .6 The Contractor is solely responsible for information pertaining to the fabrication process, techniques of construction and installation, and for co-ordination of the work of all subcontractors.
- .7 Cross-reference shop drawing information to applicable portions of Contract Documents.
- .8 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .9 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications
- .10 Shop drawings will be reviewed by the Departmental Representative for general conformance with the design concept of the project and general compliance with information given in the Contract Documents. The Departmental Representative will signify the status of the review by stamping and dating the electronic copy accordingly, in one of the following manners:
 - .1 Reviewed
 - .2 Reviewed as Noted
 - .3 Revise and Resubmit
 - .4 Not Reviewed
- .11 The Departmental Representative will return the electronic copy to the Contractor for their use and for copying for record keeping purposes and for distribution to Subcontractors and to suppliers.
- .12 The Contractor shall distribute copies of the returned shop drawings by the Departmental Representative as “Reviewed,” “Reviewed as Noted” to the Site Office and to the offices of Subcontractors, and suppliers.
- .13 Shop drawings stamped “Revise and Resubmit” or “Not Reviewed” will be returned and shall be corrected and resubmitted to the Departmental Representative following the requirements stated above.
- .14 Only shop drawings stamped “Reviewed” and “Reviewed as Noted” shall be used on the site and used for fabrication and installation of work. All other shop drawings shall be considered as being not reviewed and shall not be used on site or for fabrication and installation of work.

- .15 Conform to review comments and stamped instructions of each shop drawing reviewed.
- .16 Only drawings noted for revision and re-submission need be resubmitted. Include revisions required by previous reviews before re-submission of shop drawings.
- .17 No new details or information shall be added to shop drawings after they have been fully reviewed.
- .18 No work dependent on shop drawing information shall proceed until review is given and verification received from the Departmental Representative. Be responsible for work performed prior to receipt of reviewed shop drawings. No review comments shall be construed as authorization for Changes in the Work.
- .19 Each Subcontractor or supplier shall fabricate work exactly as shown on shop drawings and if shop practice dictates revision, shall revise shop drawings and resubmit.
- .20 File one copy of each finally revised and corrected shop drawing on site.
- .21 Consider this article the minimum requirement. Further instruction contained in any particular specification section governs for that section of the Work.
- .22 Shop drawings must be in Metric measurement.
- .23 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept. This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.
- .24 The Contractor will have a system in place to allow the Departmental Representative, Contractor and its Subcontractors to have electronic access to the project submittals, shop drawings, project communication and latest drawings on file through an internet site. The Contractor and its Subcontractors are required to access the system to obtain the latest drawings on which their shop drawings will be based. If shop drawings are submitted based on out dated drawings shop drawings will be returned without further action. The users of the electronic system, once entered into the system, will be informed electronically of updated drawings available to them on the system. Photo copies of the Departmental Representatives design drawings will not be accepted.
- .25 The Departmental Representative's CADD files shall not be used by the Contractor, its Subcontractors or Suppliers for use in preparing shop drawings.
- .26 A copy of final reviewed shop drawings in electronic format shall be included in operating and maintenance manuals specified under Section 01 78 00.

1.3 PRODUCT DATA

- .1 Product data: manufactures catalogue sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products.
- .2 Submit electronic copies of product data.
- .3 Sheet size: 215x280 mm.
- .4 Delete information not applicable to project.
- .5 Supplement standard information to provide details applicable to project.
- .6 Cross-reference product data information to applicable portions of Contract Documents.

1.4 SAMPLES

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

1.5 CERTIFICATIONS

- .1 When specified in individual specification sections, submit certification by manufacturer to the Departmental Representative to indicate material or Product conforms to or exceeds specified requirements.
- .2 Certificates may be recent or previous test results on material or Product, but must be acceptable to the Departmental Representative.

1.6 MOCK-UPS

- .1 Mock-ups: field-erected examples of work complete with specified materials and workmanship.
- .2 Erect mock-ups at locations acceptable to Departmental Representative.
- .3 Reviewed and accepted mock-ups will become standards of workmanship and material against which installed work will be verified.

1.7 MANUFACTURER'S FIELD REPORTS

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

1.8 PROGRESS DIARY

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

1.9 PHOTOGRAPHS

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

1.10 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
Submit transcription of insurance immediately after award of Contract.

1.11 ALTERNATIVE PRODUCTS

- .1 Any product other than one noted as “Acceptable Products” will be considered after tender closing and during shop drawings review as long as it is of equal or better quality and performance than the acceptable standards detailed in the corresponding specification section.

Part 2 Products

Not applicable.

Part 3 Execution

Not applicable.

END OF SECTION

Part 1 General

PWGSC Update on Asbestos Use

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

COVID 19

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

1.1 REFERENCE

- .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 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
- .4 National Fire Code of Canada 2010 (as amended)
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .5 Province of British Columbia:
 - .1 Workers Compensation Act Part 3-Occupational Health and Safety.
 - .2 Occupational Health and Safety Regulations
 - .3 WorkSafe BC OHS Regulation Part 19 – Electrical Safety

1.2 RELATED SECTIONS

- .1 Refer to the following current sections as required:
 - .1 Section 01 14 00 – Work Restrictions

- .2 Section 01 33 00 – Submittals
- .3 Section 01 51 00 – Temporary Utilities
- .4 Section 01 56 00 – Temporary Barriers and Enclosures
- .5 Section 06 10 00 – Rough Carpentry
- .6 Section 07 52 00 – Modified Bituminous Membrane Roofing
- .7 Section 07 62 00 – Metal Flashings and Trim
- .8 Section 07 92 00 – Joint Sealants

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 PSPC may terminate the Contract without liability to PSPC where the Contractor, in the opinion of PSPC, 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 33 00 – Submittals.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Site Specific 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 current 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 Health and Safety Plan and emergency procedures, and provide comments to the Contractor

within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Site Specific 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:
 - .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, revising, daily enforcing, and monitoring the Site Specific Health and Safety Plan.
 - .3 Be on site during execution of work.
 - .4 Have a minimum two (2) years' site-related working experience.
 - .5 Have working knowledge of the applicable occupational safety and health regulations.

1.8 GENERAL CONDITIONS

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
 - .2 Secure site at night time or provide security guard as deemed necessary to protect site against entry.
- .3 Section 01 56 00 – Temporary Barriers and Enclosures

1.9 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.

1.10 UTILITY CLEARANCES

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

1.11 REGULATORY REQUIREMENTS

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

1.12 WORK PERMITS

- .1 Obtain specialty permit[s] related to project before start of work.

1.13 FILING OF NOTICE

- .1 The General Contractor is to 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.
 - .11 COVID-19 Protocols and Procedures
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work.
 - .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
 - .5 Identify personal protective equipment (PPE) to be used by workers.
 - .6 Identify personnel and alternates responsible for site safety and health.
 - .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Site Specific Safety Plan and/or Health and Safety Plan as required, and re-submit to the Departmental Representative.
- .5 The review of Site Specific Safety Plan and/or Health and Safety Plan by the Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Safety Plan and/or Health and Safety Plan of responsibility for meeting all requirements of construction and Contract documents and legislated requirements.

1.15 EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an 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 [site staff].
 - .5 A route map with written directions to the nearest hospital or medical clinic.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative [site staff].
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work with hazardous substances.
 - .3 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.
- .6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.16 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling 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 SDS and WHMIS 2015 documents.
 - .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 10 01 – General Requirements.
 - .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 HAZARDOUS MATERIAL

- .1 Carry out any activities involving hazardous material in accordance with applicable Provincial regulations.
- .2 Removal and handling of hazardous materials in accordance with provincial regulation and WorkSafe BC.
- .3 Contractor to assume all paint on site contains lead and to follow WorkSafe BC procedures when disturbing any painted surface.
- .4 If any other such materials are detected on site, the Contractor is to immediately notify the Department Representatives so that the appropriate measures can be determined and implemented.

1.18 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.

1.19 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.

1.20 OVERLOADING

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

1.21 FALSEWORK

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

1.22 SCAFFOLDING

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

1.23 CONFINED SPACES

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

1.24 POWER-ACTUATED DEVICES

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

1.25 FIRE SAFETY AND HOT WORK

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

1.26 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 gasoline 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 be brought onto the work site.

1.27 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.

1.28 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.

1.29 MEETINGS

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

1.30 POSTED DOCUMENTS

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

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 CONSTRUCTION FIRE SAFETY

- .1 Be responsible for provision of construction fire safety in accordance with National Fire Code of Canada.

1.2 FIRE DEPARTMENT BRIEFING

- .1 Departmental Representative will co-ordinate arrangements for a Pre-Commencement Meeting following contract award as needed. Senior Fire Fighter or designated representative will brief Contractors regarding Fire Safety before on site work can start.
- .2 Departmental Representative will provide Contractor with a copy of all Fire Orders.

1.3 REPORTING FIRES

- .1 Inform Departmental Representative and Senior Fire Fighter of fire incidents at construction site, regardless of size.
- .2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm pull station.
 - .2 Telephone.
- .4 Person activating fire alarm pull station will remain at main entrance of site to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.4 FIRE SAFETY PLAN

- .1 Prepare a fire safety plan for construction site prior to commencement of on site work.
- .2 Submit fire safety plan to Departmental Representative for review by local fire department. Implement changes or recommendations made by local fire department into fire safety plan.
- .3 Limit scope of fire safety plan to area of construction only. Existing fire safety plans covering other existing buildings are not responsibility of this construction contract.
- .4 Post fire safety plan at entrance to construction site or near construction site's health and safety board.
- .5 Prepare fire safety plan in conformance with National Fire Code of Canada. Include:
 - .1 Emergency procedures in case of fire, including:
 - .1 Sounding fire alarm.

- .2 Notifying fire department.
- .3 Instructing occupants on procedures followed when fire alarm sounds.
- .4 Evacuating occupants, including special provisions for persons requiring assistance.
- .5 Confining, controlling and extinguishing fires.
- .2 Appointment and organization of designated supervisory staff to carry out fire safety duties.
- .3 Training of supervisory staff and other occupants in their responsibilities for fire safety.
- .4 Documents including diagrams, showing type, location and operation of building fire emergency systems.
- .5 Holding of fire drills (where applicable).
- .6 Control of fire hazards in the building.
- .7 Inspection and maintenance of building facilities provided for the safety of occupants.

1.5 FIRE WARNING SYSTEM

- .1 Provide a fire warning system for entire construction site, capable of notifying construction personnel of a fire emergency in construction area.
- .2 Provide system with sufficient coverage so that alarms are capable of being heard throughout building and anywhere on site.

1.6 FIRE PROTECTION SYSTEM IMPAIRMENT

- .1 Maintain existing systems in an operational state at all times during construction.
- .2 Use of fire hydrants, standpipes or hose systems for purposes other than fire fighting unless authorized by Senior Fire Fighter, is prohibited.
- .3 Existing fire protection and alarm systems will not be obstructed, shut off, disabled or left inactive at end of each working day or shift without written authorization from Senior Fire Fighter.
- .4 Submit written notification to Departmental Representative and Senior Fire Fighter 48 hours in advance of planned interruption of services. Submit written notification for operation including shutting down active fire protection system, including water supply, fire suppression, fire detection and life safety systems.
- .5 Where a fire protection system that provides fire alarm monitoring is impaired in an existing building, provide a fire watch as directed by Senior Fire Fighter.
- .6 Conduct work on fire protection system where systems are affected or impaired in accordance with National Fire Code of Canada conforming to Base Fire Orders.

1.7 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as scaled by Senior Fire Fighter, necessary to protect work in progress and contractor's physical plant on site.
- .2 Provide supplemental fire extinguishers to these areas and otherwise as directed by Senior Fire Fighter:
 - .1 Adjacent to hot works.
 - .2 Areas where combustibles materials are stored.
 - .3 Adjacent to areas where flammable liquids or gases are stored or handled.
 - .4 Near or on internal combustion engines.
 - .5 Adjacent to temporary oil fired or gas fired equipment.
 - .6 Adjacent to bitumen heating equipment.
- .3 Provide extinguishers rated as follows: 4A:40BC. Minimum 20 pounds unless otherwise directed by Senior Fire Fighter.
- .4 Provide dry chemical type extinguishers unless otherwise required by hazard being protected.
- .5 Provide sufficient numbers of extinguishers based on a maximum travel distance between extinguishers of 23.0 meters (75 feet).

1.8 INSTALLATION OR REPAIR OF ROOFS

- .1 Notify Senior Fire Fighter of location of asphalt kettles and dates that kettles will be in use. Ensure personnel use and take precautions as follows:
 - .1 Use kettles equipped with thermometers or gauges in good working order.
 - .2 Locate kettles in safe place outside of building or, if approved by Senior Fire Fighter, on non-combustible roof. Locate to avoid danger of igniting combustible material below.
 - .3 Maintain continuous supervision while kettles are in operation and provide metal covers for kettles to smother flames in case of fire. Provide fire extinguishers sized to accommodate kettle and contents.
 - .4 Prior to start of work, demonstrate container capacities to Senior Fire Fighter.
 - .5 Use only glass fibre roofing mops.
 - .6 Leaving used roofing mops unattended on roof is prohibited. Store mops away from building and combustible materials.
 - .7 Store roofing materials no closer than 3.0 metres from structures.

1.9 ACCESS FOR FIRE FIGHTING

- .1 Provide and maintain access for firefighting in accordance with National Fire Code of Canada.

- .2 Provide written notification to Senior Fire Fighter a minimum of 5 working days in advance of operation that would impede fire apparatus response including:
 - .1 Violation of minimum horizontal and overhead clearances.
 - .2 Other operations as directed by Senior Fire Fighter.
 - .3 Erecting of barricades and digging of trenches.
- .3 Maintain a minimum clear horizontal width on access routes of 5.0 meters or otherwise as defined by Senior Fire Fighter.
- .4 Maintain a minimum vertical clearance of 6.0 meters or otherwise as defined by Senior Fire Fighter.

1.10 SMOKING PRECAUTIONS

- .1 Smoking is prohibited in buildings including buildings under construction.
- .2 Obey posted signs and confine smoking only to designated smoking areas. Observe posted smoking restrictions near existing buildings.

1.11 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials to a minimum.
- .2 Burning of rubbish is prohibited.
- .3 Remove rubbish from work site at end of each work day or shift or more frequently as directed by Senior Fire Fighter.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove at end of each work day.
- .5 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.
- .6 Under no circumstances dispose of rubbish or waste materials on adjoining property.
- .7 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

1.12 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handle, store and use flammable and combustible liquids in accordance with National Fire Code of Canada and as otherwise directed by the Senior Fire Fighter.
- .2 Store flammable and combustible liquids such as gasoline, kerosene and naphtha in quantities not exceeding 45 litres. Store in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Obtain written authorization from Senior Fire Fighter for storage of quantities of flammable and combustible liquids exceeding 45 litres.

- .3 Transfer of flammable or combustible liquids within buildings or on jetties is prohibited.
- .4 Transfer of flammable or combustible liquids in vicinity of open flames or any type of heat-producing devices is prohibited.
- .5 Use of flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents is prohibited.
- .6 Storing flammable and combustible waste liquids on site is prohibited. Remove daily or more frequently as directed by Senior Fire Fighter.

1.13 HOT WORKS

- .1 Implement a hot works program in accordance with National Fire Code of Canada and NFPA 51B Standard for Fire Prevention. Apply hot works program to processes involving welding, cutting, roofing and other hot works as defined by Senior Fire Fighter.
- .2 Obtain a "Hot Works" permit from Senior Fire Fighter for hot works in construction area. Frequency of renewal for hot works permits is at discretion of the Senior Fire Fighter.
- .3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Senior Fire Fighter.
- .4 Provide fire watch service for work as directed by Senior Fire Fighter and as defined in Fire Department Briefing. Provide fire watchers trained in use of fire extinguishing equipment.
- .5 Carry out hot works processes in areas free of combustible and flammable content.
- .6 Where hot works must be carried out in areas where combustibles are present:
 - .1 Protect flammable and combustible materials within 15.0 meters of hot works in accordance with National Fire Code of Canada.
 - .2 Provide a fire watch during hot work and for a minimum of 60 minutes after work is complete unless otherwise directed by Senior Fire Fighter.
 - .3 Conduct a final inspection of area not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .7 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to areas where the hot work is carried out:
 - .1 Cover or close openings in walls, floors or ceilings to prevent passage of sparks to such adjacent areas.
 - .2 Provide a fire watch during hot works and for a minimum of 60 minutes after work is complete.

- .3 Conduct a final inspection not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .8 Protection of flammable or combustible materials:
 - .1 Remove flammable and combustible materials including combustible or flammable dust or residue from area where hot works is carried out.
 - .2 When removal is not possible, protect materials with a non combustible covering.
- .9 Provide a fire extinguisher within 3.0 meters of hot works. Provide a minimum size of 20 lbs Type ABC extinguisher unless otherwise directed by Senior Fire Fighter.

1.14 HAZARDOUS SUBSTANCES

- .1 Perform work involving the use of toxic or hazardous materials, chemicals or explosives, or otherwise creating hazard to life, safety or health, in accordance National Fire Code of Canada (NFC).
- .2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate sources of ignition. Provide written notification to the Senior Fire Fighter a minimum of 5 days prior to starting work and immediately at completion of work.

1.15 QUESTIONS OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety to Departmental Representative.
- .2 Departmental Representative will obtain clarifications from Senior Fire Fighter. Do not contact directly with Senior Fire Fighter for notification, authorization or any requests unless situation constitutes an immediate emergency.

1.16 FIRE INSPECTION

- .1 Co-ordinate site inspections by Senior Fire Fighter through Departmental Representative.
- .2 Allow Senior Fire Fighter unrestricted access to work site.
- .3 Co-operate with Senior Fire Fighter during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by Senior Fire Fighter.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit [2] copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .6 Include in Environmental Protection Plan:
 - .1 Name[s] of person[s] responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Name[s] and qualifications of person[s] responsible for manifesting hazardous waste to be removed from site.
 - .3 Name[s] and qualifications of person[s] responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
 - .6 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
 - .7 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

- .8 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .9 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .10 Waste Water Management Plan identifying methods and procedures for management discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .11 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .12 Pesticide treatment plan to be included and updated, as required.
- .13 Protection measures for potential Western Painted Turtle encounters. The Western Painted Turtle (Rocky Mountain Population) is considered a species of special concern under the Species at Risk Act. If work occurs between March and July, which is when hatchlings emerge from their nests and adult females begin nesting, it is required that works (including marshalling, storage and ground altering) occur only during the day time where possible and that the crew and/or an environmental monitor performs a complete sweep of all work areas for turtles before any work is initiated. This includes areas in which equipment will be moved to and utilized on site. All site inspections should be documented and records provided upon request. If turtles are encountered, Airport Staff should be contacted immediately and work should be curtailed until the turtles are relocated. Please note, Western Painted Turtle hatchlings emerging from their nest will only be the size of a toonie. For construction/demolition activities that occur during other times of the year, it is important that all Western Painted Turtle encounters follow any current/updated procedures established by Transport Canada.

1.3 FIRES

- .1 Fires and burning of rubbish on site is permitted only when approved by Departmental Representative.
- .2 Where fires or burning is permitted, prevent staining or smoke damage to structures, materials or vegetation which is to be preserved.
 - .1 Restore, clean and return to new condition stained or damaged work.
- .3 Provide supervision, attendance and fire protection measures as directed.

1.4 DRAINAGE

- .1 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- .3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.
- .4 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.

1.5 POLLUTION CONTROL

- .1 Maintain temporary pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
 - .1 Provide temporary enclosures where directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.6 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

1.7 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

Not applicable

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 19 – Construction Waste Management and Disposal.
 - .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from Departmental Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 19 – Construction Waste Management and Disposal.
- .5 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 19- Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 13– Selective Building Demolition

1.3 REFERENCES TO REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2015 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Perform work in accordance with National Energy Code (NECB) 2017.
- .3 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
 - .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.4 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.
- .3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.

1.5 BUILDING SMOKING ENVIRONMENT

- .1 Smoking is not permitted on the airport site.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittals.

1.2 REFERENCES

- .1 Refer to 01 10 01 - General Requirements.

1.3 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order 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 at no additional cost.

1.4 INDEPENDENT REVIEW AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Contractor for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Contractor. Submit for approval by Departmental Representative proposed Independent Inspection/Testing Agencies
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised at no cost to Departmental Representative. Contractor is responsible for costs of retesting and additional reviews.

1.5 ACCESS TO WORK

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

1.6 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 orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.7 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.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Department Representative will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by the Departmental Representative.

1.8 REPORTS

- .1 Submit one copy of field review and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being reviewed or tested, manufacturer or fabricator of material being reviewed or tested.

1.9 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.

- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 Mock-ups may remain as part of Work, if acceptable to Departmental Representative.

1.10 EQUIPMENT AND SYSTEMS

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

1.11 MILL TESTS

- .1 Submit mill test certificates as required of specification Sections.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Indicate use of supplemental or other staging area.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use and restore all surfaces to original condition

1.3 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain ramps, platforms, ladders, scaffolding, and temporary stairs.

1.4 HOISTING

- .1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists and cranes to be operated by qualified operator.
- .3 Protection of pedestrian and vehicles shall be provided by the contractor when hoisting operation impact any pedestrian or vehicular right-of-way.
- .4 Inform of, and coordinate with, the Departmental Representative when any such work will occur.
- .5 Refer to Appendix A - Plan of Construction Operations for requirements of Contractor Compounds and for limitations on height of equipment.

1.5 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 weight or force that will endanger Work.

1.6 CONSTRUCTION PARKING

- .1 Refer to 01 11 01- Use of Site.
- .2 Provide and maintain adequate access to project site.

- .3 Clean runways and taxi areas where used by Contractor's equipment.
- .4 Make good damage to existing roads used for access to project site.
- .5 Build and maintain temporary access where required and provide snow removal during period of Work.
- .6 Park vehicles outside perimeter fence in designated parking areas

1.7 OFFICES

- .1 Refer to 01 10 01 – General Requirements.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Refer to 01 11 01 – Use of Site.

1.9 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 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.

1.10 CONSTRUCTION SIGNAGE

- .1 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .2 Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project or earlier if directed by Consultant.

1.11 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Refer to Section 01 14 00 - Work Restrictions.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

- .6 Dust control: adequate to ensure safe operation at all times.

1.12 CLEAN-UP

- .1 Refer to Appendix A - Plan of Construction Operations.
- .2 Remove construction debris, waste materials, packaging material from work site daily.
- .3 Clean dirt or mud tracked onto paved or surfaced roadways.
- .4 Store materials resulting from demolition activities that are salvageable.
- .5 Stack stored new or salvaged material not in construction facilities.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Protection of the Work, Work in Progress, Property, and Persons by all Sections.
- .2 The Contractor shall take all reasonable precautions necessary to protect the Work and property from damage during performance of the Contract, and shall make good any damage to the Work or property caused by the Contractor or any of its Subcontractors.
- .3 Ensure all property is protected from dust and damage. Interior areas that require access outside of working hours are to be cleaned at the end of each work shift to provide a functional environment for the user.
- .4 The Contractor is responsible for any damage to all property, mechanical equipment, motors, elevator equipment, fixtures, air intakes, etc., resulting from dust contamination from the Work.
- .5 The Contractor shall completely enclose and ventilate the work areas (fresh air in and exhaust out) without allowing any dust to escape from the work area. The exhaust system must filter the dust out of the air before it is released into the atmosphere. All exhaust systems must be filtered and directed to the outside through ducting, which is to be installed in a manner acceptable to the Departmental Representative. Filters are to be cleaned and replaced regularly.
- .6 Protection shall be provided for all entrance and exit-ways, floors, walls and all standing fixtures, air intakes and equipment rooms.
- .7 Areas that are to be protected but still require access such as stairs will be hoarded using temporary vestibules. Pressurization to be adjusted by Contractor (by providing necessary fans) to prevent dust from entering these areas.
- .8 Contractor shall patch and repair all finishes or painted surfaces damaged during the course of the Work. This includes surfaces damaged by tape, fasteners, or similar materials during hoarding and protection.
- .9 Contractor shall not keep secure doors open for extended periods without the Departmental Representative's permission. Any resulting damage caused to building finishes or equipment, and any resulting property losses due to compromised building security, shall be the responsibility of the Contractor.

1.2 WALK-THROUGH INSPECTION OF SITE

- .1 Prior to start of Work, Contractor and Departmental Representative will perform walk-through inspection of site to determine existing conditions.
- .2 The Contractor is to perform a thorough inspection of the site prior to the start of work and provide a written notice to the Departmental Representative that details all damaged property as well as all items that appear to be of poor working order or appearance (i.e. sign, fixtures, dirt, etc...).

- .3 Upon receiving this notice, the Departmental Representative will review the validity of the items listed.
- .4 If written notice is not given within five (5) days of commencement of Work, it will be assumed that the Contractor has reviewed the site and has accepted the condition of the property as being free of damage.
- .5 Any damages not listed as part of the written notice of clause 1.2.2 above found after the completion of the work will be the sole responsibility of the Contractor to rectify. These rectifications shall be completed in a timely and satisfactory manner.
- .6 The project will not be considered substantially performed if the cost to correct these outstanding deficiencies is greater than the limits outlined in the Construction Lien Act.

1.3 THE WORK, WORK IN PROGRESS, PROPERTY AND PERSONS

- .1 Protect the Work during construction from damage by weather.
- .2 Provide protection as required to protect work in progress and other property from damage and to provide suitable conditions for the progress of finishing work.
- .3 Contractor review and check the exact location and height of existing equipment, parapets and structures, and shall coordinate all work to prevent interference, disturbance, physical contact and possible damage. Report all damage to the Departmental Representative.
- .4 Provide means for protecting occupied areas below the Work from water leakage between the removal and reinstallation of the waterproof membrane.
- .5 Take reasonable and required measures, including those required by authorities having jurisdiction, to protect the public and those employed on the Work from bodily harm.
- .6 Comply with requirements of The British Columbia Occupational Health and Safety Regulations for Construction Projects.
- .7 The Contractor shall be prepared to provide respirators, dust protection, ear protection for those employed by the Departmental Representative at the Site.
- .8 Direct all Subcontractors to protect their own work, existing property, adjacent public and private property and work of other Sections from damage while working.
- .9 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .10 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.4 CONSTRUCTION SIGNAGE

- .1 Contractor shall provide all required signage necessary to protect the public from the construction, control the traffic flow through the work areas and to inform patrons that construction activity is in process.

- .2 Additional signs may be required at the discretion of the Departmental Representative as construction progresses. No extras will be entertained for signage requirements after tenders close
- .3 All signage to be of professional quality and design.
- .4 Typical signage that may be required are as follows:
 - .1 Two-way traffic
 - .2 Keep right or left
 - .3 Yield, stop, detour
 - .4 One way traffic
 - .5 No parking, directional arrows, etc.
 - .6 Keep Out: Work in Progress
 - .7 Caution: Work Overhead
- .5 Signage will be required at all access gates and entrances to the work area . This signage shall consist of the standard “Men at Work” sign with an additional signs (special order) indicating that the area is temporarily under construction and we are sorry for the inconvenience.
- .6 Signage is required at all stairwell entrances to the work area. Signs to indicate that this entrance to garage is temporarily closed for construction.
- .7 All signage is to be securely fastened directly to hoarding or, if signage is required and hoarding is not available, the signs are to be securely fastened to 2 screw jack (post shores) which are fully tightened to the slab soffit and slab surface. Signs and posts are to be installed in such a manner that projections that may cause public injury are not created.

1.5 CONSTRUCTION BARRIERS AND ENCLOSURES

- .1 All work areas are to be completely enclosed by hoarding and dust protection and only accessible to the Contractor and the Departmental Representative.
- .2 Contractor shall supply and construct hoarding, barriers and enclosures as indicated in these specifications, drawings and as directed by the Departmental Representative as the construction progresses.
- .3 No extras shall be entertained for hoarding, barriers and enclosures after tenders close unless the scope of work is significantly changed.
- .4 The work areas are to completely enclosed to keep the dust generated by the construction activity from escaping into the other areas of the site or interior areas.
- .5 The Contractor is responsible for any damage to mechanical equipment, motors, elevator equipment, fire alarm system/devices, etc... resulting from dust contamination.

- .6 Areas that are to be protected but still require access, such as elevator lobbies and stairs, will be hoarded using temporary vestibules. Pressurization to be adjusted by Contractor by providing necessary fans to prevent dust from entering these areas.
- .7 The following types of enclosures/ hoarding systems will be required for this construction project:
 - .1 Type 1 - Full Height Hoarding

This system is to consist of 3/4 inch plywood with full height supported by 2" x 4" construction grade studs at maximum 2'-0" c.c. Continuous 2" x 4" top and bottom plates are to be supplied and wedged tight to the floor and soffit. A continuous sheet of poly-weave tarping is to be installed on the inside of the plywood (i.e. between the plywood and the studs) and is to be wrapped over and under the hoarding to create a dust tight enclosure.

 - .1 At exterior locations the hoarding is to be 8'-0" high.
 - .2 At interior locations full height implies from floor to soffit.
 - .3 Provide temporary dust tight enclosure and protection for exterior openings until permanently closed.
 - .4 This system shall be supplied in the following locations:
 1. Around construction doorways to work areas
 - .2 Type 2 - Full Height Dust Protection

This system consists of full height poly-weave tarping fastened to the floor and soffit with 2" x 4" construction grade wood nailers wedged tight to the floor and soffit with 2 x 4 studs or post shores at 4'-0" c.c. The seams of the poly-weave tarping, if any, are to be fastened together with duct tape.

 - .1 The main purpose of this system is to control dust and keep it from escaping from the work area, thus must be dust tight.
 - .2 This system shall be supplied to enclose all areas at which dust generating activities are to be performed, including areas below which soffit repairs are performed.
 - .3 Type 3 – Perimeter of Work Area Enclosure

This system consists of minimum 8' high steel modular fencing. This fencing is to fully enclose all areas of work (with exception of the roof). Contractor is to maintain within fenced areas at all times and access them from within the building. Contractor will require BC Commissionaire escort supervision while initially erecting the fencing and when it is removed. Refer to 01 32 19 – Security for Commissionaire information.

.4 Type 4 – Guardrails and Excavations

Provide secure, rigid guard rails and barricades around deep excavations, open edges of floors and roofs etc. Provide as required by governing authorities.

- .8 Exterior side of hoarding is to be painted white. The Contractor shall be responsible to maintain the condition of hoarding and for additional painting of hoarding required to cover graffiti.
- .9 All seams in poly-weave tarping and hoarding are to be taped together to provide dust tight enclosure.
- .10 Anchor holes are to be repaired after construction hoarding has been removed. Contractor to repair all finishes and painted surfaces damaged by fastening materials used as part of the hoarding and protection systems.
- .11 Restrict access for unauthorized personnel by placing barricades or posting guards around areas of the Work. Unauthorized personnel shall mean the public and anyone not directly concerned with the execution, supervision or inspection.
- .12 In exterior location, that is, area exposed to weather, are to be protected against weather conditions that may hinder the performance of work in these areas.

1.6 EXISTING BUILDINGS, CURBS, ROADS, LANES AND LANDSCAPING

- .1 Protect existing buildings, structures, curbs, roads, lanes and hard and soft landscaping. If, during work, any existing items are damaged, repair or replace them.
- .2 Provide pavement, curb and sidewalk protection for public thoroughfares and the Work in progress as required by the authorities and to protect public property and the Work.
- .3 The Contractor shall remove and re-install all steel bollards anchored to slab surface in areas where repairs are to be performed. Re-install bollards after waterproofing has been re-installed.

1.7 CONTROL OF CONSTRUCTION GENERATED DUST, DEBRIS, FUMES, ETC.

- .1 Dust, dirt, construction debris, water and fumes from the work areas must not be permitted to enter areas of the building or rooms in or adjacent to work areas. Resulting damage caused by contamination is the responsibility of the Contractor.
- .2 Protection shall be provided for all entrance and exit ways, floors, walls and all standing fixtures, air intakes, exhaust fan openings, floor drains, elevators and equipment rooms against dust, spillage or overspray of materials and/or damage during the construction period. The required protection shall consist of but is not limited to the following:
 - .1 Filter cloth in all floor drains within the work area
 - .2 Filter cloth over all intake and exhaust louvers and openings

- .3 Poly-weave tarping over doorways and around the exterior perimeter of work area to prevent the escape of dust & debris from the work area.
- .4 Protect sprinkler heads with Polyethylene or filter cloth to prevent dust build up
- .3 Provide for protection of vehicles in or near the area of work and payment for cleaning or damage to vehicles.
- .4 The Contractor shall be allowed to use the existing exhaust system to evacuate air from the enclosed work area to the exterior. The Contractor shall be required to connect into the exhaust fan outlet through the use of flexible ducts or equivalent hung from the slab soffit. In addition, the Contractor is to install filters to remove suspended particles of dust prior to the air entering the Departmental Representative's exhaust system. The Contractor shall incur all costs for the installation, operation, maintenance and removal of their material, temporary ductwork and filters.

1.8 PROTECTION OF EXISTING EXPOSED FACILITIES

- .1 Existing lighting system is to be protected from damage or removed and re-installed upon completion of repairs.
- .2 If Contractor wishes to use existing lighting system as an alternate to installing temporary light, Contractor shall assume all responsibility for damages incurred.
- .3 All exposed conduit, fixtures, attached devices, sprinkler fire system plumbing, mechanical system components, louvres and ducts are to be protected against the accumulation of dust, debris and damage. The Contractor will be responsible to correct any damages to these systems at their own expense. Contractor to promptly report any damage to the Departmental Representative.
- .4 Protect existing parking garage control equipment, overhead doors, etc. from damage.
- .5 Inspect materials, equipment and components to be re-used or turned over to the Departmental Representative. Note their condition and advise Departmental Representative in writing, of any defects or conditions which would affect their removal and re-use, prior to removal.
- .6 Prior to commencing Work, contact the Departmental Representative to locate all protective or alarm systems and sensors. All services shall be protected against damage or interruption. All claims resulting from damage shall be the responsibility of the Contractor.
- .7 Contractor must notify Departmental Representative, or Property Manager of any fault or alarm to the main fire alarm panel immediately. When Contractor's activities result in charges to Service the fire alarm panel or alarm system, the Contractor shall bear all costs.
- .8 Any damage to existing surfaces or finishes to remain caused by the construction shall be repaired by the Contractor at no cost to the Departmental Representative.

- .9 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.
- .10 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.
- .11 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .12 Record locations of maintained, capped and re-routed services lines.

1.9 OVERLOADING

- .1 Load no part of the structure during construction with a load greater than its designed capacity.
- .2 Submit equipment weights and construction procedures to the Departmental Representative for review prior to commencing the Work.
- .3 Make every temporary support as strong as the designed permanent support.
- .4 Place no load on concrete slabs until they have cured and have achieved sufficient strength to bear the load safely.

1.10 FIRE PROTECTION

- .1 Take necessary precautions to eliminate fire hazards and to prevent damage to the Work, building materials, equipment and other property both public and private having to do with the Work. Inspect the Work at least once a week for this purpose.
- .2 Store and locate products and equipment packed in cardboard cartons, wood crates and other combustible containers in orderly and accessible manner. Place approved types of firefighting equipment in vicinity of products packed in this type of crate or carton until permanent fire protection and equipment are available.
- .3 Do not store flammable products such as paint or fuel on site, except in Departmental Representative-approved locations, if available.
- .4 Tarpaulins to be fire-resistant.
- .5 Open fires or burning of rubbish or debris are not permitted on the Site.

1.11 OVERHEAD PROTECTION

- .1 The Contractor shall erect and maintain pedestrian walkway including roof and side covers, complete with electrical lighting, to protect the public and property from injury or damage.
 - .1 Minimum extent of overhead protection as designated on drawings.
 - .2 Minimum unobstructed overhead height of 2.4 metres. Minimum unobstructed width of at least 2 metre greater than the combined width or access doors and side lights at entrances. Minimum length shall provide

protection for a clear distance of 10 metres horizontally from the nearest swing stage.

- .3 Overhead protection shall be capable of supporting any load likely to be applied to it, and capable of supporting a load of at least 2.4 kN/m².
- .4 Install and provide adequate temporary lighting within the entire length of the overhead protection. Type, quantity and attachment of light fixtures to be approved by Departmental Representative.
- .5 Apply plywood panels to sides vertically flush and butt-jointed. Paint sides of plywood enclosures in colors selected by Departmental Representative, with one coat primer to CGSB 1-GP-59M and one coat exterior paint to CGSB 1-59M + Amdt-Aug-84.
- .6 All overhead protection and enclosures to be marked with safety signage.
- .7 All overhead enclosures and protection to be maintained daily, keeping them clean, orderly and graffiti free.
- .8 Remove temporary facilities from site promptly when directed by Departmental Representative.

1.12 SITE ENCLOSURES

- .1 The Contractor shall erect and maintain site enclosures to completely enclose the Work area, to protect the public and property from injury or damage.
 - .1 Minimum extent of site enclosure as designated on drawings. Minimum length shall provide protection for clear distance of 10 metres horizontally from the nearest swingstage.
- .2 Minimum site enclosure construction shall consist of:
 - .1 This system consists of minimum 8' high steel modular fencing. This fencing is to fully enclose all areas of work (with exception of the roof). Contractor is to maintain within fenced areas at all times and access them from within the building. Contractor will require BC Commissionaire escort supervision while initially erecting the fencing and when it is removed. Refer to 01 32 19 – Security for Commissionaire information.
- .3 All enclosures to be marked with safety signage.
- .4 All enclosures and protection to be maintained daily, keeping them clean, orderly and graffiti free.
- .5 Remove temporary facilities from site promptly when directed by Departmental Representative.

Part 2 Products

Not applicable.

Part 3 Execution

Not applicable.

END OF SECTION

Part 1 General

1.1 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 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.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 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.

1.2 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.3 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 will 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.

1.4 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.

1.5 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.

1.6 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.

1.7 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.8 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

1.9 REMDIAL 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.

1.10 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

1.11 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.

1.12 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.

1.13 CONTRACTOR'S OPTIONS FOR SELECTION OF PRODUCTS FOR TENDERING

- .1 Products are specified by “Prescriptive” specifications: select any product meeting or exceeding specifications.
- .2 Products specified under “Acceptable Products”: 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 “Special Instructions to Tenderers”.
- .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative obtain from manufacturer and independent laboratory report showing that the product meets or exceeds the specified requirements.

1.14 SUBSTITUTION AFTER CONTRACT AWARD

- .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 item5 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 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.
- .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.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all specification sections.

1.2 WASTE REMOVAL AND CLEANING

- .1 The Contractor shall maintain the Place of the Work free from unsightly or hazardous accumulations of waste materials and rubbish, and shall perform all required cleaning during the Work.
- .2 Provide on-site containers for collection of waste materials and rubbish.
- .3 All wastes, which create hazardous conditions, must be removed from the premises daily.
- .4 Disposal of all waste products to be performed in strict accordance with the product manufacturer Safety Data Sheets (SDS), and in accordance with the provincial Waste Control Regulations. Drainage systems shall not be used to dispose of Project wastes and materials.
- .5 Ensure all moisture sensitive equipment (i.e. exposed electrical and mechanical systems, etc.) are removed or protected against moisture infiltration during washing and dust-generating activities.
- .6 Remove all construction-related grease, dust, dirt, stains, labels, fingerprints, over-spray and other foreign materials immediately prior to the Departmental Representative's final review. Return all adjacent areas, equipment, duct work, etc. to the Departmental Representative in a dust-free condition. Leave site in a neat and tidy condition at completion of the Work.

1.3 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss Waste Management Plan and Goals.
- .2 Waste Management Goal is to divert a minimum 75% materials of total Project Waste from landfill sites.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage. Specific material target percentages for reuse and/or recycling:
 - .1 Masonry and pavement: 100%.
 - .2 Ceilings and walls: 100%.
 - .3 Metals: 100%.
 - .4 Mechanical - HVAC: 100%.
 - .5 Mechanical - plumbing piping: 100%.
 - .6 Mechanical - fixtures: 100%.

- .7 Mechanical - other: 50%.
- .8 Doors and windows: 100%.
- .9 Wood: 100%
- .10 Finish carpentry and millwork: 100%.
- .11 Flooring: 75 %.
- .12 Electrical - wiring/conduits/boxes: 100%.
- .13 Electrical - lighting: 75%.
- .14 Electrical - other: 75%.
- .15 Roofing: 75%.
- .16 Miscellaneous - furnishing/specialized equipment: 75%.
- .17 Packaging: 100%.

1.4 DEFINITIONS

- .1 Class III: non-hazardous waste - construction waste.
- .2 Inert Fill: inert waste - exclusively asphalt and concrete.
- .3 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .4 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .5 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .6 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Returning reusable items including pallets or unused products to vendors.
- .7 Separate Condition: refers to waste sorted into individual types.
- .8 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .9 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities.

1.5 ADMINISTRATION PROCEDURES

- .1 Designate personnel to act as the WCM. Person shall have 2 years minimum experience with construction waste procedures.
- .2 WCM shall prepare WRM and be responsible for coordinating and implementing the MMSP. All trades, subcontractors, suppliers, shipping companies and manufacturers shall adhere to instructions issued from WCM with respect to management of construction waste.

1.6 WASTE REDUCTION WORKPLAN (WRW)

- .1 Prepare WRW prior to project start-up.
- .2 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .3 WRW should include but not limited to:
 - .1 Applicable regulations.
 - .2 Specific goals for waste reduction, identify existing barriers and develop strategies to overcome them.
 - .3 Destination of materials identified.
 - .4 Deconstruction/disassembly techniques and schedules.
 - .5 Methods to collect, separate, and reduce generated wastes.
 - .6 Location of waste bins onsite.
 - .7 Security of on-site stock piles and waste bins.
 - .8 Protection of personnel, Sub-Contractors.
 - .9 Clear labelling of storage areas.
 - .10 Training plan for Contractor and Sub-Contractors.
 - .11 Methods to track and report results reliably.
 - .12 Details on materials handling and removal procedures.
 - .13 Recycler and reclaimer requirements.
 - .14 Quantities of materials to be salvaged for reuse or recycled and materials sent to landfill.
- .4 Requirements for monitoring on-site wastes management activities.
- .5 Describe management of waste.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

1.7 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

- .1 Implement MSSP for waste generated on project.
- .2 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .3 Provide containers to deposit reusable and recyclable materials.
- .4 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .5 Locate separated materials in areas which minimize material damage.

- .6 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
 - .1 Transport to approved and authorized recycling facility.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
- .8 Ship materials to site operating under Certificate of Approval.
- .9 Materials must be immediately separated into required categories for reuse or recycling.

1.8 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Consultant.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is required.
 - .2 Remove co-mingled materials to off-site processing facility for separation.

1.9 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, liquid containing solids, volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers.
- .3 Transport waste materials to licensed disposal facilities.
- .4 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.

- .5 Provide Departmental Representative with receipts indicating quantity of material delivered to landfill.
- .6 Provide Departmental Representative with receipts indicating quantity and type of materials sent for recycling.
- .7 Remove materials on-site as Work progresses.
- .8 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in the waste audit.

1.10 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

1.11 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.

1.12 SCHEDULING

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

Not applicable

Part 3 Execution

3.1 APPLICATION

- .1 Perform Work in compliance with WRW and MSSP.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

- .1 Separate materials from general waste stream and stockpile in separate piles or containers, and consistent with applicable fire regulations.
 - .1 Mark containers or stockpile areas.
 - .2 Provide instruction on disposal practices.
- .2 On-site sale of recyclable materials is not permitted.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative inspection.
 - .2 Departmental Representative Inspection:
 - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted and balanced and fully operational.
 - .4 Certificates required by authorities having jurisdiction.
 - .5 Commissioning of all systems: Final commissioning reports have been submitted to the Departmental Representative
 - .6 Operation of systems: demonstrated to Departmental Representative's personnel.
 - .7 Work: complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Departmental Representative and Contractor.
 - .2 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.

1.2 FINAL CLEANING

- .1 Clean in accordance with Section 01 10 01 – General Requirements.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: refer to 01 74 19- Waste Management and Disposal.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

1.0 MANUAL

- .1 An organized compilation of maintenance and renewal data including detailed technical information, documents and records describing maintenance of individual products or systems as specified in individual sections of Divisions 2 through 32. Also including identification of, and contact information for, specific individual trades and suppliers for work as specified in individual sections of Divisions 2 to 32.

2.0 GENERAL

- .1 Assemble, coordinate, bind and index required maintenance and renewal data into Maintenance and Renewal Manual.
- .2 **Submit a review copy of the completed Maintenance and Renewal Manual to the Departmental Representative two (2) weeks prior to application for Certificate of Substantial Performance. Attach draft or example copies of specific warranties/guaranties if required.**
 - .1 A Deficiency Holdback of \$5,000 (prior to factoring) may be enforced for non-delivery of the completed maintenance manual as noted above.
- .3 Submit electronic and two (2) hard copies in English.
- .4 Organize data into same numerical order as Contract specifications.
- .5 Material: Label each section with tabs protected with celluloid covers fastened to dividing sheets.
- .6 Type lists and notes. Handwritten summaries will not be accepted.
- .7 Drawings, diagrams and manufacturers literature must be legible. Provide direct print offs, in colour where applicable, from manufacturers websites. Copies of re-faxes shall not be accepted.
- .8 Refer also to specific Third Party Warranty Provider's requirements.

3.0 BINDERS

- .1 Binders: vinyl, hard covered, 3" "D" ring, loose leaf, sized for 215 x 280 mm paper, with spine pocket.
- .2 Identify contents of each binder on spine.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

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

4.0 CONTENTS

- .1 Cover sheet containing:
 - .1 Date submitted.
 - .2 Project title, location and project number.
- .2 Maintenance and Renewal Manual, including but not limited to the following:
 - .1 General Introduction – explain the nature of operations and maintenance items, as well as items that constitute renewals.
 - .2 Contacts – Include a summary sheet of contact names, telephone, fax, e-mail and mailing addresses for all applicable parties. Include such parties as:
 - .1 General Contractor
 - .2 Specific trades
 - .3 Specific manufacturers
 - .4 Related Departmental Representatives
 - .5 Etc.
 - .3 Mechanical Information:
 - .1 Schedule and list of products and systems, indexed to content of volume.
 - .2 Copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.

- .3 All extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification, including forms listed in section 23 06 02 Mechanical Forms.
 - .4 List of all the major mechanical equipment supplied, and complete set of all final reviewed shop drawings indicating equipment tag numbers.
 - .5 Certificates of inspection by authorities having jurisdiction.
 - .6 Test reports and certificates as applicable, including forms listed in section 23 06 02 Mechanical Forms.
 - .7 Complete set of as constructed drawings.
 - .8 Training: Refer to Section 01 91 41 - Demonstration and Training
- .4 General Summary of Building Envelope Principals – explain the function of various materials, components and assemblies. Include such items as:
- .1 Moisture barrier
 - .2 Air vapour barrier or vapour permeable barrier depending on confirmation of existing wall systems.
 - .3 Drainage cavity
 - .4 Insulation
 - .5 Cladding
 - .6 Etc.
- .5 Building Envelope Assemblies – explain the main assemblies, and their components related to the building envelope. Include such items as:
- .1 Wall assemblies
 - .2 Window, skylight and door assemblies
 - .3 Roofing assemblies
 - .4 Etc.
- .6 Maintenance Plan – include, in tabular form, a maintenance plan identifying specific components, recommended actions and time frames. Include such items as:
- .1 Cladding assemblies
 - .2 Sealants
 - .3 Windows
 - .4 Doors
 - .5 Exhaust vents
 - .6 Membranes
 - .7 Etc.

- .7 Renewals Plan – include, in tabular form, a summary outlining the timing, cost, and nature of component replacement. Include such items as:
 - .1 Cladding assemblies
 - .2 Sealants
 - .3 Windows
 - .4 Doors
 - .5 Membranes
 - .6 Etc.

- .8 Materials and Components Summary- include, in tabular form, a summary outlining the specific materials involved in the envelopes construction. Include the product, the product manufacturer, the trade involved in its application or installation, the warranty and technical data sheet supplied by the manufacturer. Include such items as:
 - .1 Cladding Assemblies
 - .2 Membranes
 - .3 Insulation
 - .4 Windows
 - .5 Doors
 - .6 Flashings
 - .7 Etc.

- .9 Warranties and Bonds:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
 - .4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
 - .5 Verify that documents are in proper form, contain full information, and are notarized.
 - .6 Co-execute submittals when required.
 - .7 Retain warranties and bonds until time specified for submittal.

- .10 Inspection Form – include a sample inspection form. In tabular form, identify the purpose of the inspection and how, when and where the inspections should take place. Provide space for recording of weather conditions, general observations and remarks.
- .11 Shop Drawings – attach record copies of all final applicable shop drawings.
- .12 Record Drawings – Refer to 01 78 39.

END OF SECTION

Part 1 General

1.1 WARRANTY/ GUARANTY PERIOD

- .1 Provide a three (3) year minimum warranty for all Work of the Contract, including a guaranty secured by Performance Bond for the first 2 years, commencing on the date of substantial performance.
- .2 Extended warranties beyond the three (3) year minimum period are outlined below.

1.2 WATERPROOFING SYSTEM WARRANTY

- .1 Total warranty period of five (5) years as follows:
 - .1 Warranty is to be a Joint Warranty by Contractor and Manufacturer. Submit a joint warranty certificate to the Departmental Representative that is signed by the Contractor and Manufacturer.

1.3 EXPANSION JOINT SEAL WARRANTY

- .1 Total warranty period of five (5) years as follows:
 - .1 Warranty is to be a Joint Warranty by Contractor and Manufacturer. Submit a joint warranty certificate to the Departmental Representative that is signed by the Contractor and Manufacturer.

1.4 SEALANT WARRANTY

- .1 Total warranty period of five (5) years as follows:
 - .1 Warranty is to be a Joint Warranty by Contractor and Manufacturer. Submit a joint warranty certificate to the Departmental Representative that is signed by the Contractor and Manufacturer.

1.5 AIR-VAPOUR BARRIER WARRANTY

- .1 Submit a guarantee warranty in writing in the name of the Departmental Representative that the air/vapour barrier membrane furnished and installed under this section shall remain free from all defects for a period of five (5) years from the date of Substantial Performance of the Work.
- .2 This written guarantee warranty shall cover the faithful performance of the air/vapour barrier membrane system, including immediate correction, at no expense to the Departmental Representative and at such time as the Departmental Representative may designate, of any defects due to faulty materials or workmanship appearing within five (5) years from the date of Substantial Performance of the Work.

1.6 FLAT ROOF WARRANTY

- .1 **Contractor Warranty**
 - .1 Provide extended warranty stating that all labour and material will be provided at no cost to the Departmental Representative to remedy all material and workmanship defects in the modified bituminous membrane roofing and

related membrane flashings which appear within ten years from the date of Substantial Performance of the Work. Warranty not to be pro-rated. Defects include but are not limited to: ponding in excess of manufacturer limits unless otherwise noted (whichever is more stringent), blisters, ridges, open seams, fish mouths, excessive degranulation, any defect resulting in water penetration into the roof assembly or the interior. Contractor to provide for all field review required from manufacturer to supply above warranty.

.1 Warranty to be issued on letterhead by field membrane manufacturer listing Departmental Representative, Installer, and General Contractor. Warranty to be signed and sealed by an authorized signing officer.

.2 Make all necessary repairs and replacements within 48 hours of receipt of written notification.

.3 Nothing contained in this article shall be construed as in any way restricting or limiting the liability in common law and statutory liability of the Contractor.

.2 RoofStar Guarantee Program Request

.1 Contractor to provide:

.1 RoofStar Ten (10) Year Guarantee.

.2 All roofing related components that fall under the RoofStar Guarantee program are to meet or exceed the RGC Guarantee Standards, and the RCABC Practice Manual (RPM). RGC Guarantee standards govern over the RPM. In the event of a contradiction between the Departmental Representatives specifications and the RCABC standard noted above, the more stringent shall govern.

.3 Inspections are to be performed by an RCABC Accepted Inspector in accordance with the requirements of the specified Guarantee Program. Proposed inspector name and credentials shall be submitted to the Departmental Representative for review prior to commencing inspection services.

.4 RGC Guarantee Program Costs.

.1 Inspection Costs: Shall be included in the bid .

.2 Testing Costs: Shall be included in the bid.

.3 Guarantee Cost: Final cost of the Guarantee shall be included in the bid.

.4 Re-inspection and Re-testing Costs: All re-inspection and/or re-testing costs required of the RGC Guarantee Program shall be included.

.5 Contractor shall arrange for and schedule all inspection requirements

.3 Manufacturer's System Warranty:

- .1 Obtain 20 year Manufacturer System Labour, Material, and Workmanship Warranty. Inspections to be provided by system manufacturer's representatives. Manufacturer to review drawings and specifications prior to work.

1.7 RCABC GUARANTEE

- .1 Provide the standard Roofing Contractors Association of British Columbia (RCABC) ten (10) year Guarantee.
- .2 The Contractor is to retain and pay for the services of an RCABC approved inspector, as required for the issuance of the RCABC Guarantee.
- .3 Provide a minimum Thirty (30) years guarantee for the asphalt shingle manufacturer's standard material.

Part 2 Products

Not applicable.

Part 3 Execution

3.1 REMEDIAL WORK UNDER GUARANTY/WARRANTY

- .1 Perform any required warranty repair work for the duration of the warranty period at no extra cost.
- .2 Notice will be provided to the Contractor during the warranty period within thirty (30) days of the discovery of any defect in the Work. The Contractor shall take necessary steps to protect the area against further damage immediately upon receipt of notice and shall take corrective action to make good any damage incurred. The Contractor shall schedule repair work with the Departmental Representative and shall make every attempt to make good the defects within three (3) weeks of notice.
- .3 Remedy is to be at no cost to the Departmental Representative and is to include all labour, material, equipment, and supervision necessary to make good defective areas of the Work and any damages incurred to obtain access to defective areas.
- .4 The Contractor must reimburse the Departmental Representative for any resulting assessment costs incurred to define the extent of the defect and for costs incurred to test the repaired defect to confirm acceptability of repairs.
- .5 The Contractor must reimburse the Departmental Representative for all associated costs incurred due to closure of the areas requiring repair under warranty.
- .6 Warranty periods for areas requiring repair are to be extended by the amount of time lapsed between issuance of notice and completion of remedial work. The

warranty/guaranty period will then re-commence upon completion of the remedial work.

- .7 Warranties are not to be deemed to restrict any liability of the Contractor arising out of any applicable law.

END OF SECTION

Part 1 General

1.1 RECORD DRAWINGS

- .1 Contractor to maintain two sets of white prints for record drawing purposes.
- .2 The Contractor to maintain project record drawings and record deviations from Contract documents accurately in red ink and mark on one set of prints.
- .3 Record following information:
 - .1 Field changes of dimension and detail.
 - .2 Changes made by Change Order, Change Directive, or Supplemental Instruction.
 - .3 Deviation from electrical and mechanical installations shown on drawings.
 - .4 Other significant deviations that are concealed in construction and cannot be identified by visual inspection.
 - .5 Type and location of structural repairs, delaminations, etc.
 - .6 Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
- .4 At completion of contract and prior to final review, neatly transfer "as-built" records to second set of white prints using a fine red marker. Neatly print lettering and numbers in size to match original. Lines may be drawn free-hand, but shall be neat and accurate. Add at each drawing title block note: "AS-BUILT RECORD". Circle on List of Drawings each title and number of drawings marked with "as-built" records. Each "as-built" drawing to have statement and signature from Contractor's Project Manager confirming accuracy.
- .5 Submit both sets of "as-built record" drawings to Departmental Representative on completion of Contract and before substantial completion.
- .6 Make project record drawing available at all times for reference purposes and for review by the Departmental Representative. Provide reproducible prints to Departmental Representative at regular intervals but not less than once each month.
- .7 In addition to requirements in General Conditions, maintain at the site one record copy of:
 - .1 Contract Drawings;
 - .2 Specifications;
 - .3 Addenda;
 - .4 Change Orders and other modifications to the Contract;
 - .5 Reviewed shop drawings, product data, and samples;
 - .6 Field test records;

- .7 Inspection certificates;
- .8 Manufacturer's certificates.
- .8 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

1.2 RECORDING ACTUAL SITE CONDITIONS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Equipment And Systems:
 - .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
 - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .6 Provide servicing and lubrication schedule, and list of lubricants required.
 - .7 Include manufacturer's printed operation and maintenance instructions.
 - .8 Include sequence of operation by controls manufacturer.
 - .9 Provide original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - .10 Provide installed control diagrams by controls manufacturer.
 - .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
 - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .14 Include all test and balancing reports.
 - .15 Additional requirements: As specified in individual specification sections.
- .2 Materials And Finishes:
 - .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.
- .3 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .4 Maintenance Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .5 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual

Part 2 Products

Not applicable.

Part 3 Execution

Not applicable.

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 CSA Standard Z320 -2011 Building Commissioning
- .2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems

1.3 DEFINITIONS

- .1 Commissioning Authority (CxA) – an individual identified by the Departmental Representative to lead the commissioning team in the implementation of the commissioning process. Departmental Representative will engage and pay for the services of an independent 3rd party Commissioning Authority.
- .2 Contractor’s Commissioning Agent (CxAg) – a specialist retained by the mechanical contractor to execute mechanical commissioning activities.

Respectively, an electrical commissioning agent may be retained depending on the electrical project requirements.

- .3 Prime Contractor's Commissioning Manager (CxMgr) – an individual appointed by the prime contractor to manage the daily commissioning activities occurring within the general contract. Typically, this role is merged in with the Prime contractor's site supervisor, with common activities delegated to the mechanical commissioning agent.
- .4 Commissioning Team – the group responsible for planning, implementing and executing the commissioning activities throughout the project phases. The commissioning team will typically include the Commissioning Authority, Commissioning Agents, Commissioning Manager, sub-contractors, equipment suppliers, O&M personnel, Building Operation's Representative, and Departmental Representative.

1.4 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the OMM.
 - .3 Effectively train O M staff.
- .2 Contractor(s) assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by the design consultant, to meet the Project functional and operational requirements.
- .4 Commissioning Manager and Commissioning Agent(s) shall coordinate their commissioning activities to avoid redundancy and inefficiencies.
- .5 Commissioning Manager (prime contractor) shall be the main point of contact for daily management of all commissioning activities, and shall be responsible for ensuring all activities and deliverables are collected and submitted to the Commissioning Authority as described herein.

1.5 COMMISSIONING OVERVIEW

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

1.6 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.7 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to the Commissioning Authority.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.

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

1.8 CONFLICTS

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

1.9 ACTION AND INFORMATIONAL SUBMITTALS

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

1.10 COMMISSIONING DOCUMENTATION

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

1.11 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule. Clearly identify start and end dates for each new mechanical equipment and controls decommissioning task.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Review and approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training (Systems demonstrations).

1.12 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings. Minimum of [3] Cx meetings: Kickoff (60%), 90% progress, and final.
- .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, Cx Manager and/or Cx Agent to call a Cx kickoff meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meetings will be chaired by the Cx Manager and/or the Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at kickoff (60%) and subsequent Cx meetings and as required.

1.13 STARTING AND TESTING

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

1.14 WITNESSING OF STARTING AND TESTING

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

1.15 MANUFACTURER'S INVOLVEMENT

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

1.16 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain recommended approval from Commissioning Authority after distinct phases have been completed and before commencing next phase.
- .4 Document the required tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Commissioning Authority. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures recommended by the Commissioning Authority.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures recommended by the Commissioning Authority.
 - .3 If evaluation report concludes that major damage has occurred, Commissioning Authority shall reject equipment use.
 - .1 Rejected equipment to be removed from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.17 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.

- .3 Signed installation/start-up check lists.
- .4 Start-up reports,
- .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.18 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

1.19 TEST RESULTS

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

1.20 START OF COMMISSIONING

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

1.21 INSTRUMENTS / EQUIPMENT

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

1.22 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual and/or simulated operating conditions, over entire operating range, in all modes.

- .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.23 WITNESSING COMMISSIONING

- .1 Commissioning Authority to witness activities and verify results.

1.24 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Commissioning Authority within [1] week of test and with Cx report.

1.25 COMMISSIONING CONSTRAINTS

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

1.26 EXTRAPOLATION OF RESULTS

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

1.27 EXTENT OF VERIFICATION

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

1.28 REPEAT VERIFICATIONS

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

1.29 SUNDRY CHECKS AND ADJUSTMENTS

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

1.30 DEFICIENCIES, FAULTS, DEFECTS

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

1.31 COMPLETION OF COMMISSIONING

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

1.32 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.33 TRAINING / SYSTEMS DEMONSTRATION

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

1.34 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.35 OCCUPANCY

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

1.36 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with the Commissioning Authority.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.37 PERFORMANCE VERIFICATION TOLERANCES

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

1.38 PERFORMANCE VERIFICATION TESTING

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

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 CSA Standard Z320 -2011 Building Commissioning
- .2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems

1.3 GENERAL

- .1 Provide a fully functional mechanical and electrical system:
 - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
 - .2 Building Operations Representatives, Airport Manager and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Cx.
 - .4 Describes process of verification of how built works meets the project requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.

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

1.4 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 95% completed before the start of commissioning in the construction phase.
- .2 Cx Plan to be 100% completed [2] weeks prior to the start of commissioning activities, take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Requirements of Contractor, sub-contractor, suppliers.
 - .6 Project construction team's and Cx team's requirements.

- .3 Submit completed Cx Plan to Commissioning Authority, obtain written review and recommended approval.

1.5 REFINEMENT OF CX PLAN

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

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

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

- .7 Reviewing performance verification results of installed systems and equipment
- .8 Reviewing implementation of Training Plan.
- .3 Construction Team: prime contractor, contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning Commissioning Manager as point of contact with Commissioning Authority, Departmental Representative, and PWGSC Cx Manager for administrative and coordination purposes.
- .4 Contractor's Cx agent executes specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training.
 - .3 Testing.
 - .4 Preparation, submission of test reports.
- .5 Building Operations Representative, Airport Manager, O&M Manager: represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.

- .4 Specialist Cx agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
- .5 Client: responsible for intrusion and access security systems.
- .6 Ensure that Cx participant:
 - .1 Could complete work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O M personnel.
 - .4 Redistribution of electrical services.
 - .5 Modifications of fire alarm systems.
 - .6 Modifications to voice communications systems.
 - .7 Provide names of participants to the Commissioning Authority and details of instruments and procedures to be followed for Cx [2] weeks prior to starting date of Cx for review and recommended approval.

1.8 RISK ASSESSMENT

- .1 Not used.

1.9 EXTENT OF CX

- .1 Cx Structural and Architectural Systems:
 - .1 Not applicable.
- .2 Commission mechanical systems and associated equipment:
 - .1 HVAC systems:
 - .1 Air Handling Units
 - .2 Fans
 - .3 HVAC Controls and Graphics
 - .2 Noise and vibration control systems for mechanical systems.
 - .1 Air Handling Units
 - .2 Fans

- .3 Seismic restraint and control measures.
 - .1 Rooftop mounted equipment
 - .2 Ceiling and wall mount mechanical equipment
- .3 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Fire alarm shutdown of AHUs

1.10 DELIVERABLES RELATING TO O M PERSPECTIVES

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

1.11 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
 - .1 Cx as used in this section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
 - .1 Startup, pre-Cx activities and documentation for systems, and equipment.

- .2 Completed installation checklists.
- .3 Completed product information (PI) report forms.
- .4 Completed performance verification (PV) report forms.
- .5 Results of Performance Verification Tests and Inspections.
- .6 Description of Cx activities and documentation.
- .7 Description of Cx of integrated systems and documentation.
- .8 Tests witnessed by Commissioning Authority and/or PWGSC Design Quality Review Team:
- .9 Tests performed.
- .10 Training (Systems Demonstrations) Plans.
- .11 Cx Reports.
- .12 Prescribed activities during warranty period.
- .4 Contractor's Commissioning Agent to witness and review tests and reports of results prior to providing to Cx Mgr and Cx Authority.

1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

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

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

1.13 **START-UP**

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

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

1.14 CX ACTIVITIES AND RELATED DOCUMENTATION

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

1.15 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by the Commissioning Authority and/or alternate procedures proposed by the Contractor's commissioning agent and reviewed by the Cx Authority prior to commencement.
- .2 Tests to be witnessed by the Cx Authority and documented on approved report forms by the Cx Agent.
- .3 Upon satisfactory completion, Cx agent to prepare Cx Report, to be reviewed by the Commissioning Authority for recommended approval.
- .4 Commissioning Authority reserves the right to verify up to 50% percent of reported results at no cost to contract.
- .5 Integrated systems to include:
 - .1 Air Handling Units fire alarm integration
 - .2 Air Handling Units controls and monitoring
 - .3 Fan controls and monitoring

.6 Identification:

- .1 In later stages of Cx, before hand-over and acceptance Contractor's commissioning agent to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, and main systems.

1.16 INSTALLATION CHECK LISTS (ICL)

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

1.17 PRODUCT INFORMATION (PI) REPORT FORMS

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

1.18 PERFORMANCE VERIFICATION (PV) REPORT

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

1.19 DELIVERABLES RELATING TO ADMINISTRATION OF CX

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

1.20 CX SCHEDULES

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

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

1.21 CX REPORTS

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

1.22 ACTIVITIES DURING WARRANTY PERIOD

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

1.23 TRAINING PLANS

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

1.24 FINAL SETTINGS

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

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 INSTALLATION/START-UP CHECK LISTS

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

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

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

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

1.4 PERFORMANCE VERIFICATION (PV) FORMS

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

1.5 SAMPLES OF COMMISSIONING FORMS

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

1.6 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .2 Confirm operation as per design criteria and intent.
 - .3 Identify variances between design and operation and reasons for variances.
 - .4 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .5 Record analytical and substantiating data.
 - .6 Verify reported results.
 - .7 Form to bear signatures of recording technician and reviewed and signed off by Cx Agent.
 - .8 Submit immediately after tests are performed.
 - .9 Reported results in true measured SI unit values.
 - .10 Provide Commissioning Authority with originals of completed forms.
 - .11 Maintain copy on site during start-up, testing and commissioning period.

- .12 Forms to be both hard copy and electronic format with typed written results for insertion into the OMM.

1.7 LANGUAGE

- .1 English.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 TRAINEES

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

1.3 INSTRUCTORS

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

1.4 TRAINING OBJECTIVES

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

1.5 TRAINING MATERIALS

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

1.6 SCHEDULING

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

1.7 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 Commissioning Authority will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative, Commissioning Authority, and/or Building Operations Manager.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.
 - .9 Inter-Action among systems during integrated operation.
 - .10 Review of O M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.
- .4 Contractor shall include all travel costs and related expenses. Provide two separate training sessions, each minimum 2 hours in length. First session before Substantial Completion and the second training to be held 3 months after all deficiencies are corrected during Occupancy.

Part 2 Products

Not applicable

Part 3 Execution

Not applicable

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Installation of hoarding/dust protection and shoring around the Work as indicated on phasing drawings as per section 01 10 01 – General Requirements.
- .2 Provide all labour, material, equipment and supervision required to remove and dispose of all material and debris resulting from the removal of existing roof, exterior wall, window, and door systems.

Part 2 Products

Not applicable.

Part 3 Execution

3.1 INSPECTION

- .3 Visit and examine the site and note all characteristics and features affecting the Work of this Section.
- .4 Ensure all services, whether buried; built-in or exposed are properly identified as to position, type of service, size, direction of flow.
- .5 Inspect materials, equipment, components to be re-used or turned over to the Departmental Representative. Note their condition and advise the Departmental Representative in writing of any defects or conditions which would affect their removal and re-use.

3.2 PREPARATION

- .1 Prevent movement, settlement or damage of elements of the existing building which are to remain. Provide bracing, shoring and supports as required. Protect existing surfaces not to be restored from damage during removal procedures.
- .2 Cut and/or cap existing services within the work area, if any, prior to start of Work as required, but do not affect the services of areas not under construction or essential to the ongoing operation of the building.
- .3 In all cases, exercise all reasonable care during removal operations to avoid damaging items to be salvaged, re-used, or items that are not part of the Scope of Work.

- .4 Seal off all work areas to prevent dust and debris from affecting other areas outside of the work area. Prevent public access to areas being repaired.
- .5 Tape and/or seal and provide protection to all mechanical and electrical services and all fire alarm and security devices still functioning adjacent to the work areas to prevent damage resulting from dust, water, or impact.
- .6 Cover drains as required to prevent any construction related materials and debris from entering the drains. Ensure that all drains continue to operate as required during construction.
- .7 Remove or protect in place all surface mounted or permanent fixtures not to be demolished from damage during demolition procedure.
- .8 Apply filter cloth to all exhaust and ventilation vents within work area to prevent dust generated by the construction activity from escaping.
 - .1 Contractor shall clean, or replace filter cloth if the filter cloth becomes unsuitably dirty as determined by Departmental Representative.
- .9 Provide proposed demolition sequence to the Departmental Representative for review prior to commencing work.
- .10 Contractor to provide their own power for the duration of the project.
- .11 Submit details of proposed bracing to the Departmental Representative for review prior to commencing work.
 - .1 Details to be designed and stamped by Registered Professional Engineer in the Province of British Columbia.

3.3 DEMOLITION

- .1 Remove and dispose of material and debris resulting from the removal of the existing roofing system to the level of the structural deck depending on the seismic upgrades. Existing system shall be totally removed from the deck surface leaving a clean, sound, and smooth surface suitable for the placement of new materials to the approval of the Departmental Representative.
- .2 Remove and dispose of material and debris resulting from the removal of soils and granular subgrades as per Contract Documents.
- .3 The concrete slabs to be demolished shall be removed by sawcutting techniques.

- .4 Jack hammer demolition of concrete shall be restricted to those areas where existing slab reinforcement is to be preserved intact and at locations adjacent to vertical surfaces where saw cut cannot reach, or where undercutting is required.
 - .1 Jackhammer size is specified in Section 03 01 32.
- .5 Demolition procedures and equipment shall meet all applicable noise-control by-laws and regulations of the location of the work.
- .6 The Contractor is to take care not to damage the surface of sound material which is to remain through the removal operation. Where any such damage is done, it is to be repaired by the Contractor at their own expense to the approval of the Departmental Representative.
- .7 Where new concrete is to be applied to existing concrete, the surface is to be left clean and sound.
- .8 All required re-painting due to damage, overspray, etc. is the Contractor's responsibility.
- .9 At end of each day's work, leave work in safe condition so that no part is in danger of causing injury or damage.

3.4 WASTE DISPOSAL

- .1 Disposal of waste products and material is to be in strict accordance with the product manufacturer's material safety data sheets and in accordance with the governing waste control regulations.
- .2 The existing drainage system is not to be used to dispose of project wastes and / or materials.
- .3 Store volatile wastes or material in covered metal containers. All wastes which create hazardous conditions must be removed from the premises daily.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Refer to the following reports (further referred to herein as the “Assessment Reports”), attached in the Appendix of the Project Specifications, for information pertaining to hazardous building materials that have been identified and may require disturbance (removal and disposal) during the Work:
 - .1 SNC Lavalin Inc. Report No. 636476 entitled Hazardous Building Materials Assessment; Penticton Airport Terminal Building, 3000 Airport Road, Penticton, BC, dated March 31, 2016
 - .2 Stantec Report No. 123221854 entitled Pre-Construction Hazardous Building Materials Assessment; Roof and Building Envelope Renovation – Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road, Penticton, dated June 15, 2021

1.2 DEFINITIONS

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

1.3 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 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada Institute for Research in Construction (NRC-IRC)
 - .1 National Fire Code of Canada 2015.
- .4 Department of Justice Canada
 - .1 Transportation of Dangerous Goods Act (TDG Act) 1999, (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2003-400).

- .5 Government of Canada
 - .1 The Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations (COHSR)
 - .2 The Federal PCB Regulations (SOR/2008-273).
 - .3 The Federal Halocarbons Regulation (July 2003).
- .6 Public Services and Procurement Canada
 - .1 Asbestos Management Directive (June 5, 2017)
 - .2 Asbestos Management Standard (June 5, 2017)
- .7 WorkSafe BC
 - .1 British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97), including amendments to date of work)
 - .2 "Safe Work Practices for Handling Asbestos" (2017)
 - .3 "Lead-Containing Paints and Coatings; Preventing Exposure in the Construction Industry" (2011)
 - .4 "Safe Work Practices for Handling Lead" (2017)
- .8 Government of British Columbia
 - .1 British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
- .9 Canadian Construction Association
 - .1 Standard Construction Document CCA 82 "Mould Guidelines for the Canadian Construction Industry" (2004 – further referred to herein as "CCA 82").

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data for hazardous materials to be used by the Contractor to complete the Work:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
 - .3 Submit hazardous materials management plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .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 current National Fire Code of Canada 2015 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 Do not transfer of flammable and combustible liquids in vicinity of open flames or heat-producing devices.
- .7 Do not use flammable liquids having flash point below 38 degrees C, such as naphtha or gasoline as solvents or cleaning agents.
- .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 not mixed.
 - .6 Store hazardous materials and wastes in secure storage area with controlled access.
 - .7 Maintain clear egress from storage area.
 - .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
 - .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
 - .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
- .11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
- .12 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

1.6 TRANSPORTATION

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

1.7 EXISTING CONDITIONS

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

Part 2 Products

2.1 MATERIALS

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

Part 3 Execution

3.1 HAZARDOUS BUILDING MATERIALS ABATEMENT

- .1 Abatement shall be conducted to handle, alter, remove and dispose of hazardous building materials as identified in the Assessment Reports in accordance with applicable regulations, guidelines, standards and/or best practices for such work, only to the extent that such identified hazardous building materials will be impacted (handled, altered, damaged, removed) by the Work.
- .2 Contractor is responsible for reviewing plans, specifications and reports such that they understand the locations and amounts of hazardous building materials that will be impacted by the Work of this Contract.
- .3 Where there is a discrepancy between the information in this specification as compared to the information in the Assessment Reports as it pertains to identities, locations and/or quantities of identified hazardous building materials, the information in the Assessment Reports will prevail.
 - .1 If discrepancies are present pertaining to identities, locations and/or quantities of identified hazardous building materials, it is the Contractor's responsibility to request information to clarify such discrepancies during the bidding period. No additional costs will be allowed by the Contractor for additional labour or materials required to complete required abatement related to such discrepancies.
- .4 The listing below is a summary of the identified hazardous building material categories that are anticipated to require disturbance, along with the associated removal and disposal regulations, guidelines and/or standards.
 - .1 Asbestos-Containing Materials (ACMs)
 - .1 Refer to the Assessment Reports for identities and locations of ACMs. Although the Contractor is responsible to review this information in light of their proposed methods for completing the Work, a preliminary review indicates that the following ACMs will require consideration:
 - .1 Texture coat/stucco applied to exterior walls and soffit
 - .2 Grey window putty applied between pane and frame on interior
 - .3 Grey window frame caulking applied between frame and wall on exterior
 - .2 Actions that will disturb identified ACMs are to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication "Safe Work Practices for Handling Asbestos", by appropriately trained personnel.
 - .1 Submit Provincial and/or local requirements for Notice of Project Form.
 - .2 Submit proof of Contractor's Asbestos Liability Insurance.
 - .3 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos containing waste and proof

- that asbestos containing waste has been received and properly disposed.
- .4 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Instruction and training related to respirators is to include, at a minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
 - .3 Contractor is to conduct a risk assessment and document work procedures for actions/tasks that will or may disturb identified ACMs.
 - .1 Contractor is to submit the documented work procedures to the Departmental Representative for review, at least 10 days prior to initiation of work.
 - .2 Contractor must not proceed with work that will impact identified ACMs without approval from Departmental Representative.
 - .3 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.
 - .4 Contractor shall retain an independent, qualified third party to take air samples inside and outside of Asbestos Work Areas in accordance with the most stringent of the recommendations set forth in the Canada Labour Code Part II, Occupational Health and Safety Regulations, BC Reg. 296/97 and the 2017 WorkSafeBC Manual “Safe Work Practices for Handling Asbestos”.
 - .1 Air samples will be collected and analyzed in accordance with NIOSH method 7400.
 - .2 Air sample results will be provided to the Contractor and Departmental Representative within 24-hours of sample collection.
 - .3 Analysis will be conducted by qualified persons or laboratories that take part in a documented QA/QC program for such analysis.
 - .5 During abatement, Contractor will be notified 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.
 - .6 Subsequent to abatement, post-abatement (“air clearance”) sample results must indicate airborne fibre measurements less than 0.01 f/cc prior to the Contractor being provided with notification that containment structures can be removed.

- .7 Additional monitoring will be conducted, where possible, to verify procedural corrections were effective.
- .8 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.
 - .1 When asbestos leakage from Asbestos Work Area has occurred, or is likely to occur, Departmental Representative may order Work shutdown and correction of deficiencies.
- .9 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .4 Asbestos waste transportation and disposal to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
- .2 Lead and Lead-Containing Paints (LCPs)
 - .1 Refer to the Assessment Reports for identities and locations of identified lead-containing materials (including paints with varying concentrations of lead) that may require impacts during the Work.
 - .2 Actions that will disturb lead-containing materials (including paints and materials coated with paints) are to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication “Safe Work Practices for Handling Lead”, keeping airborne exposure to lead dust to less than COHSR and BC Reg. 296/97 regulated 8-hour Occupational Exposure Limit (OEL) for lead of 0.05 milligram per cubic metre (mg/m³).
 - .1 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.
 - .3 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 and development of Safe Work Practices that are prepared in relation to the site-specific tasks and materials to be impacted as part of their Work.
 - .1 Contractor is to submit the documented Risk Assessment and site-specific Safe Work Practices pertaining to lead to the Departmental Representative for review, at least 10 days prior to initiation of work.
 - .2 Contractor must not proceed with work that will impact identified LCPs without approval from Departmental Representative.
 - .4 Although paints and items coated with paints may be disturbed and/or removed for disposal during the Work, unless deemed necessary through risk assessment or cost analysis conducted by the Contractor,

- comprehensive removal of paints from items or surfaces is not expected to be required during the Work.
- .5 Refer to the provisions of the 2017 WorkSafeBC document “Safe Work Practices for Handling Lead” for removal of LCPs from surfaces before any welding and torch-cutting, should the Contractor plan to use such methods to complete the Work.
 - .1 Contractor will be responsible for verification testing of surfaces where LCPs have been removed. Confirmation of acceptable results is to be provided to the Departmental Representative for review before proceeding with any welding or torch-cutting on surfaces where LCPs were present.
 - .6 Waste transportation and disposal to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
 - .1 As indicated in the Assessment Reports, the following materials contain lead in a dispersible form such that their leachates contain greater than 5.0 milligrams per litre (mg/L) lead, and will require special disposal:
 - .1 Exterior white painted wood soffit materials on the raised portion of the roof.
 - .3 Polychlorinated Biphenyls (PCBs)
 - .1 As per the Assessment Reports, PCB-containing items are not anticipated to be impacted by work of the Project.
 - .2 If project requirements change, and actual or potential PCB-containing items require impacts (e.g. alteration, disturbance, handling, removal and/or disposal), notify Departmental Representative. Do not proceed with activities could impact actual or potential PCB-containing items until such time as instructions are received from Departmental Representative.
 - .4 Mould and Animal Waste Contamination
 - .1 As per the Assessment Reports, removal, alteration and/or disposal of mould-impacted materials and/or removal of animal waste contamination is not anticipated to be required during the Work.
 - .2 If project requirements change, and actual or potential mould or animal waste contamination is observed in the Project area, notify Departmental Representative. Do not proceed with activities could impact contaminated items until such time as instructions are received from Departmental Representative.
 - .5 Mercury
 - .1 As per the Assessment Reports, mercury-containing items are not anticipated to be impacted by work of the Project.
 - .2 If project requirements change, and actual or potential mercury-containing items require impacts (e.g. alteration, disturbance, handling, removal and/or disposal), notify Departmental Representative. Do not proceed with activities could impact actual or potential mercury-containing items until such time as instructions are received from Departmental Representative.

- .6 Ozone-Depleting Substances (ODSs)
 - .1 According to the Assessment Reports, the following actual or potential ODS-containing items will require impacts as part of the Project:
 - .1 One rooftop Lennox HVAC unit labelled “ACU-2” (R-22, 4 lbs., 12 oz.)
 - .2 One rooftop Lennox HVAC unit labelled “ACU-4” (R-22, 4 lbs., 12 oz.)
 - .3 One Rooftop Lennox HVAC unit labelled “ACU-5” (R-22, 7 lbs.)
 - .4 One wall-mounted Friedrich A/C on exterior of the Data/LAN room 127 (coolant unknown)
 - .2 When refrigeration equipment that is suspected or confirmed to be ODS-containing is decommissioned, it should be emptied and inspected by licensed refrigeration technician (as defined in the Federal Halocarbon Regulations).
 - .3 ODSs must be handled, recycled, stored, transported 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)
 - .2 Transportation requirements of the Federal Transportation of Dangerous Goods Regulation
 - .3 Federal Halocarbons Regulations
- .7 Silica
 - .1 According to the Assessment Reports, silica is expected to be present in the following, which may be impacted by work of the Project:
 - .1 Stucco
 - .2 Asphalt and asphalt products containing rock or stone (e.g., roof membrane)
 - .2 When silica-containing materials are to be disturbed and/or removed (e.g., demolition of concrete slabs, masonry or concrete units, removal of gypsum board/plaster walls, impacts to stucco-like wall or ceiling coatings, etc.), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and BC Reg. 296/97. (Cristobalite and Quartz – each 0.025 mg/m³). This would include, but not be limited to, the following:
 - .1 Providing workers with respiratory protection
 - .2 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
 - .3 Providing workers with facilities to properly wash prior to exiting the work area.

3.2 DISPOSAL

- .1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

- .2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.
- .3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
- .6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.
- .7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.
- .8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:
 - .1 Hazardous wastes recycled in manner constituting disposal.
 - .2 Hazardous waste burned for energy recovery.
 - .3 Lead-acid battery recycling.
 - .4 Hazardous wastes with economically recoverable precious metals.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1. SUMMARY

- .1 Comply with the requirements of this Section when performing work or removing the following asbestos containing materials (ACM):
 - .1 Drywall joint compound – all drywall joint compound in the building shall be handled as asbestos containing.
 - .2 Exterior ceiling and wall texture – was identified as asbestos containing on the south and west exterior walls and ceiling (carport area on the south end of building). All exterior wall and ceiling textured coatings shall be handled as asbestos containing.

These identified ACMs must be removed as per the WorksafeBC Safe Work Practices for Handling Asbestos Part 3: High – risk work activities, Part 6 of the OHS Regulation and OHS guidelines G6.8

1.1. REFERENCES

- .1 Reference Standards
 - .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205- [94], Sealer for Application of Asbestos-Fibre-Releasing Materials.
 - .2 Canadian Standards Association (CSA International).
 - .3 Canadian Environmental Protection Act (CEPA), 1999.
 - .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
 - .5 Transport Canada (TC):
 - .1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1999, (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (SOR/2012-245).
 - .6 British Columbia Occupational Health and Safety Regulation
 - .7 WorksafeBC Safe Work Procedure for Handling Asbestos.
 - .8 Asbestos Containment Procedures: Section 02 82 05

1.2. DEFINITIONS

- .1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.
- .2 Asbestos Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
- .3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.
- .4 Authorized Visitors: Departmental Representatives and representatives of client or Authorities having Jurisdiction.

- .5 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .6 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .7 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.
- .8 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .9 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .10 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.3. SUBMITTALS

- .1 Before beginning work:
 - .1 Submit Provincial and/or local requirements for Notice of Project for work involving asbestos (NOPA) form.
 - .2 Obtain from appropriate agency and submit to Departmental Representative all necessary permits for transportation and disposal of asbestos waste. Ensure that landfill operator is fully aware of hazardous nature of material being disposed, and proper methods of disposal. Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to receive and properly dispose of asbestos waste.
 - .3 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person on hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Submit proof of attendance in form of certificate.

- .4 Ensure supervisory personnel have attended asbestos abatement course, of not less than two days duration (i.e. Occupational Health and Safety for the Asbestos Worker), approved by Departmental Representative. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers and a clean room attendant is to be appointed and present in the event the workers within the enclosure require assistance outside of the work area.
- .5 Submit layout of proposed enclosures and decontamination facilities to Departmental Representative for review prior to commencement of site work.
- .6 Submit documentation including test results for sealer proposed for use.
- .7 Submit proof of Contractor's Asbestos Liability Insurance.
- .8 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.
- .9 Submit WorksafeBC status and transcription of insurance.
- .10 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including but not limited to following:
 - .1 Encapsulants.
 - .2 Amended water.
 - .3 Slow drying sealer.
- .11 Submit detailed work procedures with tender price outlining the methods of asbestos removal for each type of building material identified including, cleanup and disposal requirements. Provide unit rates for removal, cleanup and disposal of each type of building material identified for purposes of extra work discovered during deconstruction process.
- .12 Submit documentation that HEPA filtered equipment (vacuums and negative air units) have been certified by DOP testing (or similar).

1.4. QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to asbestos provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.

- .2 Health and Safety:
 - .1 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 Air purifying full face-mask or a personal air purifying respirator (PAPR), with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.
 - .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
 - .3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing and then place in a container for asbestos contaminated dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

- .4 Ensure workers understand decontamination procedures which may include but not be limited to washing hands and face when leaving Asbestos Work Area. Facilities for washing are to be located [as indicated on drawings].
- .5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
- .6 Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering and exiting from Asbestos Work Area.

1.5. WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and/or recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse or recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional, and Municipal regulations.
- .7 Fold up metal banding, flatten, and place in designated area for recycling.
- .8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 mil bags or leak proof drums. Label containers with appropriate warning labels.
- .9 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.6. EXISTING CONDITIONS

- .1 Reports and information pertaining to ACMs to be handled, removed, or otherwise disturbed and disposed of during this project are available for inspection. These are for general information only and are not necessarily representative of asbestos containing materials covered within scope of this Project.
- .2 Notify Departmental Representative of suspect asbestos containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.7. SCHEDULING

- .1 Not later than ten (10) days before beginning Work on this Project notify following in writing:
 - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
 - .2 Regional Office of Labour Canada.
 - .3 WorksafeBC.
 - .4 Ministry of Environment.
- .2 Inform sub-trades of presence of asbestos containing materials identified in Existing Conditions.
- .3 Submit to Departmental Representative a copy of notifications prior to start of Work.
- .4 Hours of Work: perform work during normal daytime working hours, 7am – 5pm Monday to Friday.

1.8. PERSONNEL TRAINING

- .1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

Part 2 Products

2.1 MATERIALS

- .1 Drop and Enclosure Sheets:
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.

- .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene bag (or where glove bag method is used, glove bag itself).
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.
- .4 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
- .5 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50 (and be compatible with new fireproofing, as applicable).
- .6 Encapsulant: surface film forming or penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 PROCEDURES

- .1 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)' as well as banner tape isolating the work area.
- .2 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
 - .1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface.
- .3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained and must be disposed as asbestos waste.

- .4 Work is subject to daily visual inspection and air monitoring by Departmental Representative. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas at no additional cost to the client.
- .5 Cleanup:
 - .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double bagged waste from site. Dispose in accordance with requirements of Provincial and Federal authority having jurisdiction. Supervise disposal and ensure that landfill operator is fully aware of hazardous nature of material to be disposed and that guidelines and regulations for asbestos disposal are followed.
 - .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.2 REMOVAL OF ACMs IDENTIFIED IN SECTION 1.1 (High Risk Asbestos Removal Procedures)

- .1 All abatement procedures are to be in compliance with WorksafeBC requirements.
- .2 Use full HIGH-RISK containment procedures in accordance with WorksafeBC Safe Work Procedure for Asbestos and Part 6 of BC OHS Regulation (full sealed enclosure that incorporates clean room, shower room, dirty room and is maintained under constant negative pressure using HEPA filtered negative air units).
- .3 All people within the work area shall be wearing Tyvek disposable coveralls and Powered air-purifying respirator with NIOSH P100 Series filters and laceless steel toed rubber boots.
- .4 Lightly wet drywall or wall/ceiling texture (and any associated overspray) to be removed with amended water. Use non-powered hand tools to cut out and remove all noted ACMs (including any associated overspray). Continue wetting cut line with amended water as ACMS are cut out.
- .5 Where wall/ceiling texture is covered with a coating and where practicable, pierce coating to permit saturation of contaminant with amended water. Where saturation is not possible, provide a continuous misting of amended water on affected areas during removal.
- .6 Clean up all debris and dust on polyethylene sheeting by wet wiping techniques, fold polyethylene in upon itself and remove polyethylene from work area. Dispose of polyethylene sheeting as asbestos debris in double 150 micrometer asbestos disposal bags and duct tape seal.
- .7 Utilize HEPA equipped vacuum to maintain clean work environment inside containment.

- .8 Dispose of all asbestos in appropriate waste bags and ensure they are properly sealed, taped, cleaned and double bagged.
- .9 Once work is complete, all workers should remove Tyvek disposable coverall (in dirty room) and discard as asbestos debris into asbestos disposal bags. Workers should then proceed to shower (with respirator still on) and wash head, face, body and exterior of respirator thoroughly before removing the respirator while still in shower.
- .10 Continue showering to clean remainder of body.
- .11 Proceed to clean room to don street clothes.
- .12 If respirator cartridge to be re-used, seal inlet with tape to prevent accidental release of asbestos fibres. Properly secure and store respirators.
- .13 Waste bags to be stored in secure and safe area while awaiting transport off-site.

3.3 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.4 AIR MONITORING

- .1 The Contractor is responsible for ensuring that air monitoring is completed per WorksafeBC requirements. From beginning of active abatement Work until completion of cleaning operations, Departmental Representative is to collect occupational air samples inside of the containment as well as ambient air samples on daily basis outside of Asbestos Work Area enclosure(s) in accordance with Provincial Occupational Health and Safety Regulations. Three samples to be collected daily at least (one occupational, one clean room ambient sample and one other ambient sample outside containment).
- .2 Air sample results must be available before the end of the following shift and posted on site.
- .3 If ambient air monitoring shows that areas outside Asbestos Work Area enclosure(s) exhibit an elevated fibre in air count greater than 0.02 f/cc, efforts are to be immediately taken to address the elevated measurement and reduce ambient fibre concentrations.
- .4 Ensure that respiratory safety factors are not exceeded. This will be done by interpreting the results of the occupational air samples collected inside the containment during abatement work.
- .5 After a final clean has been conducted inside the high-risk abatement enclosure, air clearance sampling must be conducted in accordance with WorksafeBC requirements. In order for the containment to be approved for dismantling, the air clearance sample results must be shown to be below 0.02 f/cc inside of the containment.

END OF SECTION

Part 1 General**1.1. SUMMARY**

- .1 Comply with requirements of this Section when performing work that may impact or disturb the following asbestos containing materials (ACM):
 - .1 Grey window putty – all windows with window putty shall be considered asbestos containing;
 - .2 Light grey vinyl floor tiles (tile only) – identified as asbestos containing in rooms 106B (within small wall compartment on west wall north of building entrance), 109, 112, 114, 125, 129, 120 (debris in floor vent) and including all similarly coloured tiles;
 - .3 Grey vinyl floor tiles (tile and associated black mastic adhesive) – identified as asbestos containing in rooms 123 and 124 and including all similarly coloured tiles;
 - .4 Green vinyl floor tiles (tile and associated black mastic adhesive) – identified as asbestos containing in rooms 127, 128A, 128B, 132, 133, 134, 135, 136 and including all similarly coloured tiles;
 - .5 Light brown vinyl floor tiles (tile only) – identified as asbestos containing in room 129 (beneath lockers on north and south walls) and including all similarly coloured tiles;
 - .6 Tan vinyl floor tiles (tile only) – identified as asbestos containing in rooms 115, 116A, 117, 119 and including all similarly coloured tiles;
 - .7 White floor leveling compound – identified as asbestos containing under the grey floor tiles in room 123 and all similar floor leveling compounds shall be handled as asbestos containing (full extent of asbestos containing floor leveling compound could not be completely defined);
 - .8 Grey concrete pipe – identified as asbestos containing in the crawlspace of room 127 and the same pipe was observed sticking out of the ground outside room 133.
All concrete pipe shall be handled as asbestos containing;
 - .9 Bell and spigot cast iron pipe joint packing (attached to the asbestos-concrete pipe) – identified as asbestos containing on the concrete pipe in Room 127 crawlspace. All similar piping joints shall be handled as asbestos containing;
 - .10 Piping gaskets (grey) – identified as asbestos containing in crawlspace of room 127 and mechanical room 137. All similar piping gaskets shall be handled as asbestos containing;
 - .11 Pipe thread sealant – identified as asbestos containing in rooms 124 and 143. All similar pipe thread sealants on fire sprinkler lines shall be handled as asbestos containing;
 - .12 Duct mastic (red) – identified as asbestos containing in the crawlspace of room 136. All red duct mastic shall be handled as asbestos containing;
 - .13 Tar on floor – identified as asbestos containing by the base of the doorframe of the southeast door of room 110;
 - .14 Fire doors – the fire doors in rooms 137 and 138 were suspected to contain asbestos. Therefore, these doors (and any other similar doors) must be handled as asbestos containing unless further inspections can determine otherwise.

These identified ACMs must be removed as per the WorksafeBC Safe Work Practices for Handling Asbestos Part 3: Moderate – risk work activities, Part 6 of the OHS Regulation and OHS Guidelines G6.8.

1.2 REFERENCES

- .1 Reference Standards
 - .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205-[94], Sealer for Application of Asbestos-Fibre-Releasing Materials.
 - .2 Canadian Standards Association (CSA International).
 - .3 Canadian Environmental Protection Act (CEPA), 1999.
 - .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
 - .5 Transport Canada (TC):
 - .1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1999, (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (SOR/2012-245).
 - .6 British Columbia Occupational Health and Safety Regulation
 - .7 WorksafeBC Safe Work Procedure for Handling Asbestos.
 - .8 Asbestos Containment Procedures: Section 02 82 05

1.3 DEFINITIONS

- .1 Asbestos Containing Materials (ACMs): a manufactured article or other material, other than vermiculite insulation, that would be determined to contain at least 0.5% asbestos
- .2 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .3 Designated work area: an area for work with asbestos-containing material which is restricted to access by authorized persons by warning signs and by barricades, enclosures or other means of isolation, with due regard for the level of risk;
- .4 Friable Asbestos Containing Materials: asbestos-containing material that is crumbled or powdered or can be crumbled or powdered by hand pressure;
- .5 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.

- .4 Straps for sealing ends around pipe.
- .6 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.
- .7 High Risk Activity: work activity that involves working with or in proximity to asbestos- containing material if a high level of control is necessary in respect of that activity to prevent exposure of a worker to airborne asbestos fibres;
- .8 Moderate risk work activity: a work activity, other than a high-risk work activity, that involves working with or in proximity to asbestos-containing material if, at the time the work activity is being carried out, one or both of the following apply:
 - .1 the asbestos-containing material is being
 - a. cut, sanded, drilled, broken, ground down or otherwise fragmented, or
 - b. disturbed such that the asbestos-containing material may release airborne asbestos fibres;
 - .2 it is necessary to use personal protective equipment or engineering controls, or both, in respect of that activity to prevent exposure of a worker to airborne asbestos fibres;
- .9 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .10 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .11 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .12 Qualified Person: means a person who:
 - .1 has knowledge of the management and control of asbestos hazards through education and training, and
 - .2 has experience in the management and control of asbestos hazards.
- .13 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.4 SUBMITTALS

- .1 Before beginning work:
 - .1 Submit Provincial and/or local requirements for Notice of Project for Work Involving Asbestos (NOPA) form.
 - .2 Obtain from appropriate agency and submit all necessary permits for transportation and disposal of asbestos waste. Ensure that landfill operator is fully aware of hazardous nature of material being disposed, and proper methods of disposal. Submit proof that suitable arrangements have been made to receive and properly dispose of asbestos waste.

- .3 Submit proof that all asbestos workers have received appropriate training and education by a competent person on hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Submit proof of attendance in form of certificate.
- .4 Ensure supervisory personnel have attended asbestos abatement course, of not less than two days duration (i.e. Occupational Health and Safety for the Asbestos Worker), approved by Departmental Representative. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers and a clean room attendant is to be appointed and present in the event the workers within the enclosure require assistance outside of the work area.
- .5 Submit layout of proposed enclosures and decontamination facilities to Departmental Representative for review prior to commencement of site work.
- .6 Submit documentation including test results for sealer proposed for use.
- .7 Submit proof of Contractor's Asbestos Liability Insurance.
- .8 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.
- .9 Submit WorksafeBC status and transcription of insurance.
- .10 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including but not limited to following:
 - .1 Encapsulant.
 - .2 Amended water.
 - .3 Slow drying sealer.
- .11 Submit detailed work procedures with tender price outlining the methods of asbestos removal for each type of building material identified including, cleanup and disposal requirements. Provide unit rates for removal, cleanup and disposal of each type of building material identified for purposes of extra work discovered during deconstruction process.
- .12 Submit documentation that HEPA filtered equipment (vacuums and negative air units) have been certified by DOP testing (or similar).

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to asbestos provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.

- .2 Health and Safety:
 - .1 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 Air purifying half face-mask, full face-mask or a personal air purifying respirator (PAPR), with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.
 - .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
 - .3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing and then place in a container for asbestos contaminated dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

- .4 Ensure workers understand decontamination procedures which may include but not be limited to washing hands and face when leaving Asbestos Work Area. Facilities for washing are to be located as notified by Departmental Representative.
- .5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
- .6 Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.6 WASTE HANDLING AND DISPOSAL

- .1 Separate waste materials for reuse and/or recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse or recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional, and Municipal regulations.
- .7 Fold up metal banding, flatten, and place in designated area for recycling.
- .8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 mil bags or leak proof drums. Label containers with appropriate warning labels.
- .9 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.7 EXISTING CONDITIONS

- .1 Reports and information pertaining to ACMs to be handled, removed, or otherwise disturbed and disposed of during this project are available for inspection. These are for general information only and are not necessarily representative of asbestos containing materials covered within scope of this Project.
- .2 Notify Departmental Representative of suspect asbestos containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.8 SCHEDULING

- .1 Not later than ten (10) days before beginning Work on this Project notify following in writing:
 - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
 - .2 Regional Office of Labour Canada.
 - .3 WorksafeBC.
 - .4 Ministry of Environment.
- .2 Inform sub-trades of presence of asbestos containing materials identified in Existing Conditions.
- .3 Submit to Departmental Representative a copy of notifications prior to start of Work.
- .4 Hours of Work: perform work during normal daytime working hours, 7am – 5pm Monday to Friday.

1.9 PERSONNEL TRAINING

- .1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

Part 2 Products

2.1 MATERIALS

- .1 Drop and Enclosure Sheets:
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.
- .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene bag (or where glove bag method is used, glove bag itself).

- .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
- .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.
- .4 Glove bag:
 - .1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during tendering period in accordance with Instructions to Tenderers.
 - .2 The glove bag to be equipped with:
 - .1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.
 - .2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct, or similar structure.
 - .3 A tool pouch with a drain.
 - .4 A seamless bottom and a means of sealing off the lower portion of the bag.
 - .5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
- .5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
- .6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50 (and be compatible with new fireproofing, as applicable).
- .7 Encapsulant: surface film forming or penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 PROCEDURES

- .1 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)' as well as banner tape isolating the work area.

- .2 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
 - .1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface.
- .3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained and must be disposed as asbestos waste.
- .4 Work is subject to visual inspection and air monitoring by Departmental Representative. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas at no additional cost to the client.
- .5 Cleanup:
 - .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double bagged waste from site. Dispose in accordance with requirements of Provincial and Federal authority having jurisdiction. Supervise disposal and ensure that landfill operator is fully aware of hazardous nature of material to be disposed and that guidelines and regulations for asbestos disposal are followed.
 - .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.2 REMOVAL OF ACMs IDENTIFIED IN SECTION 1.1 – (Moderate Risk Asbestos Removal Procedure)

- .1 All abatement procedures are to be in compliance with WorksafeBC requirements.
- .2 Clearly mark the designated work area boundary by placing barricades, fences or similar structures around the work area.
- .3 Place signs around the work area warning people not to enter the work area unless authorized to do so.
- .4 Wear appropriate protective clothing and a respirator fitted with a P100 (HEPA) filter

- .5 Install drop sheet beneath work area (if necessary), seal windows, doorways, and other openings to prevent spread of asbestos dust to other work areas prior to commencing work.
- .6 Clean up contaminated debris using a HEPA filtered vacuum or by wet cleaning and bag wetted drop sheets and barriers and disposed them as asbestos waste.
- .7 Cut and/or remove ACM, applying a mist of amended water to contaminated surfaces as materials are removed to keep airborne asbestos fibres at the lowest practicable level. Keep surfaces wet during this operation.
- .8 Where glovebag is required, remove ACM using glovebag method in accordance with glovebag manufacturer's recommendations and WorksafeBC Safe Practices for Handling Asbestos. Take care to avoid cutting glovebags.
- .9 When ready to dispose of glovebag, pull disposal bag over glove bag attached to ACM. Undo zipper to open top of glove bag and fold it down into disposal bag.
- .10 All asbestos waste to be carefully placed in appropriate waste bags, sealed, wiped down and placed in second appropriate waste bags, the sealed and wiped down also.
- .11 Waste bags to be stored in secure and safe area while awaiting transport off-site.

3.3 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.4 AIR MONITORING – NOT REQUIRED FOR MODERATE RISK WORK BUT MAY BE CONDUCTED IF DESIRED

- .1 The Contractor is responsible for ensuring that air monitoring is completed per WorksafeBC requirements. From beginning of Work until completion of cleaning operations, Departmental Representative may collect occupational air samples and air samples on daily basis outside of Asbestos Work Area enclosure(s) in accordance with Provincial Occupational Health and Safety Regulations.
- .2 Departmental Representative may also conduct monitoring inside enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations.
- .3 If air monitoring shows that areas outside Asbestos Work Area exhibit an elevated fibres in air count within 50% of the occupational exposure limit of 0.1 f/cc (0.05 f/cc), Work will cease immediately and enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.
- .4 Ensure that respiratory protection safety factors are not exceeded.

END OF SECTION

Part 1 General

- .1 Any changes to the framing shown on the drawings shall have prior written approval of the Departmental Representative. Framing changes which have not been so approved will be rejected.
- .2 Any timber not grade marked will be rejected.
- .3 Finishes shall be detailed to accommodate shrinkage of the timber over time.
- .4 Do not cover wood framing with finishes until the Departmental Representative's framing review is complete. Provide 24 hours advance notification when framing reviews are required.
- .5 Notching and drilling of structural elements and all light framing shall follow the guidelines set forth in the Building Code Part 9, unless otherwise approved in writing by the Departmental Representative.

1.2 REFERENCE STANDARDS

- .1 CSA O80 Series, Wood Preservation.
- .2 CAN/CSA O141, Softwood Lumber.
- .3 CSA O121, Douglas Fir Plywood.
- .4 CSA O151, Canadian Softwood Plywood.
- .5 CSA O153, Poplar Plywood.
- .6 CAN/CSA 0325.0 (R1998), Construction Sheathing.
- .7 CAN/CSA-O86 - The Engineering Design in Wood
- .8 British Columbia Building Code 2018 - Part 9
- .9 CSA B111, Wire Nails, Spikes and Staples.
- .10 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber, Latest Edition.
- .11 CAN/CSA-B34 - Miscellaneous Bolts and Screws
- .12 Canadian Wood-Frame House Construction-CMHC
- .13 "Wood Design Manual" - Canadian Wood Council
- .14 "Wood Building Technology" - Canadian Wood Council

1.3 SUBMITTALS

- .1 For products treated with preservative by vacuum-pressure impregnation submit following information certified by authorized signing officer of treatment plant:
 - .1 Information listed in AWPA.M2 and revisions specified in CAN/CSA-080 Series, Supplementary Requirement to AWPA Standard M2 applicable to specified treatment.
 - .2 Moisture content after drying following treatment with water-borne preservative.
- .2 Submit product data for double hot-dipped galvanized nails confirming compliance with ASTM-153.

1.4 INSTALLER QUALIFICATIONS

- .1 Maintain a qualified crew of carpenters for the work of this Section. Only qualified journeymen shall be engaged in framing and each journeyman shall have a B.C. Certificate of Proficiency.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect materials from moisture upon delivery.
- .2 Store materials on raised supports. Cover materials with waterproof covering. Provide adequate air circulation and ventilation.
- .3 Do not store seasoned materials in wet or damp areas.
- .4 Store all materials in a dry environment. Do not cover materials having a moisture content of over 15%.

Part 2 Products

2.1 LUMBER MATERIALS

- .1 Lumber: Except as otherwise specified, lumber shall be softwood, S-P-F #2 or better, S4S, kiln-dried, moisture content 15% or less, not finger jointed, and in accordance with the following standards:
 - .1 CSA O86-14
 - .2 CAN/CSA O141.

- .3 Graded and stamped in accordance with the National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber and by an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Furring, Blocking, Strapping, Nailing Strips, Grounds, Rough Bucks: S-DRY, douglas fir species.
 - .1 Board Sizes: “Standard” grade to NLGA, Paragraph 114c.
 - .2 Dimension Sizes: “Standard” grade to NLGA, Paragraph 122c.
- .3 Roofing Curbs, Nailers, Blocking, Cants: as specified in 2.1.2 above.
- .4 Wood Trim: kiln-dried spruce, comb faced fascia material.

2.2 PANEL MATERIALS

- .1 Douglas Fir Plywood: to CSA O121 with applicable grade stamp.
 - .1 Roof Sheathing: untreated Tongue & Groove, 15.5 mm (5/8”) thick. Use Select Tight Face plywood under deck membrane.
 - .2 Wall Sheathing: untreated, 12.5 mm (1/2”) thick, standard construction.
- .2 Other Panel Products: marked with a recognized, visible grade stamp.

2.3 FASTENERS

- .1 Roof Nailers: CSP material, “Sheathing” grade.
- .2 Nail, Spikes and Staples: to CSA B111 and as follows:
 - .1 Use common spiral nails and spiral spikes, except where specified otherwise, for interior work.
 - .2 Fasteners in contact with borate treated lumber: hot-dipped galvanized finished steel.
 - .3 Fasteners in contact with ACQ treated lumber: stainless steel.
 - .4 If P-nails (power driven nails) are intended as a substitution, submit P-nails information for the Departmental Representative review prior to use. Adjustment of nails spacing or requirements may be required.
- .3 Bolt, Nut, Washer, Screw and Pin Type Fasteners: hot-dipped galvanized finished steel for all fasteners in contact with borate treated lumber or stainless steel for all fasteners in contact with ACQ treated lumber, unless specified otherwise.
- .4 Joist Hangers: hot-dipped galvanized finished steel for all hangers, plates, straps, etc. in contact with borate treated lumber or stainless steel for all such connectors in contact with ACQ treated lumber.

- .5 Do not combine stainless steel fasteners with galvanized hardware or vice-versa.
- .6 Miscellaneous steel to be CSA G40.21 or approved equal.
- .7 Timber connection hardware to be Simpson Strong-Tie, Canada scaffold supply, MGA connectors or equivalent approved by the Departmental Representative. Complete with nails supplied by manufacturer. Do not use p-nails.
- .8 Anchor rods shall be ASTM F1554 Grade 36 or approved equivalent. Anchor rods shall be deformed, threaded along their full length or hooked 1 1/2" at the bottom.
- .9 Bolts shall be ASTM A307 or approved equal, used with standard cut steel washers unless noted otherwise on drawings. Bolt holes shall be 1 mm larger than the bolt diameter. Bolts in wood shall not be less than 7 diameters from the end and 4 diameters from the edge unless otherwise detailed.
- .10 Lag screws shall be predrilled with a bit size of 65% of the shank diameter for the threaded portion. Lead holes shall be the same length as the unthreaded portion and the same diameter as the shank. Screw all lags into place. Cut washers shall be provided under heads which bear on wood.
- .11 No checks or splits allowed at areas to be bolted or lagged.
- .12 All fasteners and connection hardware through preservative treated materials or outside of the moisture barrier to be hot dipped galvanized or stainless steel as specified.
- .13 Nailing shall conform to the Building Code Part 9, and "Wood Building Technology" published by the Canadian Wood Council. Nailing called up on these drawings (i.e. for sheathing) is based on common nails.
- .14 Unless noted otherwise nail all wall and roof sheathing with 2 1/2" nails at 6" o/c at supported edges of sheathing sheets, and at 12" o/c for roofs at intermediate supports to all supporting members. If smaller diameter nails (i.e. pneumatically driven nails or 'p-nails') are used, increase the number of nails by 33%.
- .15 Do not use pneumatically driven nails with joist hangers or connecting hardware. Nails for hardware should be as specified or supplied by manufacturer.

2.4 MOISTURE BARRIERS

- .1 Provide a moisture barrier between wood elements and all concrete or masonry. This can be a sheet of light-gauge (24 gauge minimum) galvanized metal, asphalt impregnated building paper (15 pounds per 100 square feet), closed-cell foam gasket material, or type s roll roofing. Sheet polyethylene not permitted. All

junctions and terminations to be lapped (2" minimum) and sealed. Butt joints in moisture barriers not permitted.

2.5 PRESERVATIVE TREATMENT

- .1 Treat following items in accordance with applicable CAN/CSA O80 commodity standard using alkaline copper quat type C (ACQ-C) or copper azole type B (CA-B) preservative to obtain minimum net retention of 4.0 kg/m³ of wood. Materials shall be kiln-dried after treatment
 - .1 All dimension lumber and panel materials directly exposed to moisture (i.e. deck boards, trellis and similar such framing, exposed stairs).
 - .2 Treat following items in accordance with applicable CAN/CSA 080 commodity standard using "Advance Guard" borate-pressure treatment to obtain minimum net retention of 2.7 kg/m³ of wood. Materials shall be kiln-dried after treatment. Lumber shall carry the Canadian Wood Preserver's Bureau Quality Mark ("Advance Guard" quality mark).
 - .1 New lumber and panel materials inside, outside and crossing the wall moisture barrier.
 - .2 Items in contact with concrete or masonry.
 - .3 Furring, blocking, strapping, etc. for rainscreen cavity provisions.
 - .4 Roofing curbs, nailers, blocking, and cants.
 - .3 Inspection of products treated with preservative by vacuum-pressure impregnation will be carried out by an accredited inspection agency of the Canadian Wood Preservers Bureau (CWPB).
 - .4 All treated lumber and plywood shall bear an identifying stamp in accordance with the CWPB, CSA 080 or AWWPA requirements.
 - .5 Following water-borne preservative treatment, dry material to maximum moisture content of 15%.

2.6 ACCESSORIES

- .1 Polyethylene Film: to CAN/CGSB-51.34-M86, 100 micrometres thick.
- .2 Sealing Tape: minimum 60 mm width, polypropylene sheathing tape with acrylic adhesive, or duct tape of same width.
- .3 Sill Gaskets: closed-cell vinyl foam, with moisture-resistant properties.

Part 3 Execution

3.1 FIELD TREATMENT OF PRESERVATIVE TREATED AND EXISTING PRODUCTS

- .1 Field treat surfaces exposed by cutting, trimming or boring of preservative-treated items with liberal application of preservative and in accordance with AWWA M4.
- .2 Apply preservative in accordance with manufacturer's instructions. Apply by dipping, by brush or by spray to completely saturate and maintain wet film on surface for minimum three-minute soak on lumber and one minute soak on plywood. Allow to dry 24 hours prior to covering.
- .3 Preservative field treat all existing lumber and plywood sheathing that is located on the interior of the moisture barrier (sheathing paper).
- .4 Preservative treat strapping and all wall sheathing where replaced.

3.2 ERECTION OF FRAMING MEMBERS

- .1 Install members true to line, levels and elevations, square and plumb. Space uniformly.
- .2 Construct continuous members from pieces of longest practicable length.
- .3 Install spanning members with "crown-edge" up.
- .4 Install blocking to facilitate installation of finishing materials, fixtures, specialty items and trim.
- .5 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .6 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .7 Countersink bolts where necessary to provide clearance for other work.
- .8 Install foam sill gaskets between wood and concrete.

3.3 WOOD FURRING AND BLOCKING

- .1 Provide wood furring and blocking at locations indicated on Drawings and as specified.

3.4 NAILING STRIPS, GROUNDS AND ROUGH BUCKS

- .1 Install rough bucks, nailer and linings to rough openings as required to provide backing for frames and other work.
- .2 Erect all wood framing members level and plumb. Construct to framing member's full height without splices.

3.5 ROOF AND WALL SHEATHING

- .1 Install roof and wall sheathing in accordance with B.C. Building Code requirements except as follows:
- .2 Install wall sheathing with panel end-joints located on solid bearing, staggered at least 800 mm.
- .3 Lay roof sheathing with the surface grain at right angles to the joists. Stagger the joints parallel to the joists.
- .4 Sheathing on load bearing walls or shear walls shall be fastened directly to the studs, without the use of resilient metal channels.
- .5 Fasten wall sheathing panels spaced 150 mm O.C. along edges and 300 mm O.C. along intermediate supports. Do not use staples.
- .6 Nails shall not be placed less than 9 mm from the panel edge and shall not be over-driven more than 15% of the panel thickness.

3.6 ROOF BLOCKING, NAILERS, CANTS, CURBS

- .1 Install wood items required for roofing and sheet metal work.
- .2 Construct wood curbs for roof mounted equipment, anchors and for roof penetrations, except drains. Curb heights measured from finished roof membrane:
- .3 200 mm for plumbing vents.
- .4 250 mm for other curbs.
- .5 Mechanically fasten plywood facing to parapets, and walls at roof-wall/parapet junctions.
- .6 Screw top 38 x 89 mm plates of building control joint box to plywood sides. For roofing control joint box use nails. Leave 25 mm gap between top plate ends every 2.4 m.

- .7 Support edges of plywood backslope sheets. Bevel edge of sheets that meet structural deck.
- .8 Attach curbs, control joint boxes, blocking and framing directly to structure.

3.7 WOOD TRIM AND FASCIAS

- .1 Install wood trim and fascia boards using finishing nails set slightly below the surface.
- .2 Mitre joints to disguise shrinkage.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 10 00 - Rough Carpentry,

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A208.2-09, Medium Density Fibreboard (MDF) for Interior Applications.
 - .2 ANSI/HPVA HP-1-10, American National Standard for Hardwood and Decorative Plywood.
 - .3 ANSI/BHMA A156.16 Auxiliary Hardware.
 - .4 ANSI/ASME 18.6.1 1981 (R2012) Wood Screws (Inch Series).
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
 - .1 Architectural Woodwork Quality Standards, 2nd edition, 2014.
- .3 ASTM International
 - .1 ASTM A 153/A 153M-16, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 ASTM F1667-13 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
- .5 CSA International
 - .1 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .2 CSA O151-09 (R2014), Canadian Softwood Plywood.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittals.

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, data sheets and catalogue pages for specified products. Include product characteristics, performance criteria, dimensions and profiles, finish and limitations on use.
- .3 Samples:
 - .1 Submit triplicate 300 mm long representative samples of each typical item of finish carpentry.
 - .1 Standing and running trim: 300 mm long.

1.4 QUALITY ASSURANCE

- .1 Perform Work of this Section by finish carpentry contractor with minimum 5 years of current experience and having completed minimum one project in the past 5 years with value within 20% of the cost of the work of this Section.
- .2 Mock-ups:
 - .3 Construct mock-ups in accordance with Section 01 33 00 – Submittals.
 - .4 Shop prepare one typical example of each specified item of standing and running trim, complete with shop applied finishes, and install where directed by Departmental Representative.
 - .5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with Work.
 - .6 When accepted, mock-up will demonstrate minimum standard for Work.
 - .7 Accepted mock-up may remain as part of finished work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with AWS recommendations and as follows.
- .2 Deliver finish carpentry materials only when area of work is enclosed, plaster and concrete work is dry, area is broom clean and site environmental conditions are acceptable for installation.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Maintain indoor temperature and humidity within range recommended by AWS for location of the Work.
- .3 Store products on site as specified for minimum 72 hours prior to installation.
- .4 Store and protect finish carpentry products from moisture, nicks, scratches, and blemishes.
- .5 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Softwood and hardwood lumber: Sound lumber to specified AWS grade requirements, kiln-dried to moisture content recommended for location of the Work.
 - .1 Machine stress-rated lumber is acceptable for all purposes.
- .2 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .3 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .4 Hardwood plywood: to ANSI/HPVA HP-1.

2.2 FASTENINGS

- .1 Provide screws, bolts, expansion shields and other fastening devices required for satisfactory installation.
- .2 Exposed fasteners to match finish of hardware.
- .3 Nails and staples: to ASTM F1677, galvanized to ASTM A 153/A 153M for exterior work, interior humid areas; plain finish elsewhere.
- .4 Wood screws: to ANSI/ASME 18.6.1, countersunk flush type unless indicated otherwise, in sizes to suit application, galvanized to ASTM A 153/A 153M for exterior work, interior humid areas, plain for other locations.
- .5 Splines: wood.

2.3 STANDING AND RUNNING TRIM

- .1 Softwood Lumber: to CSA 0141 and National Lumber Grades Authority requirements, s-dry with maximum moisture content of 12% for interior work, selected for opaque and transparent finishes as applicable.

- .2 Miscellaneous Trim: to NLGA para. 103C “C and Better” grade, douglas fir species.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood products installation in accordance with AWS tolerances and requirements of Contract Documents.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Back prime woodwork before installation, to AWS.

3.3 INSTALLATION

- .1 Install items of finish carpentry in accordance with AWMAC AWS grade specified for respective items.
- .2 In case of conflict between Contract Documents and AWS grade requirements, Contract Documents govern.
- .3 Install items of finish carpentry at locations shown on drawings.
 - .1 Position accurately, level, plumb straight.
 - .1 Fasten and anchor securely.
- .4 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.
- .5 Make joints smooth, flush and tight.
- .6 Use skilled workers experienced in finish carpentry trade.
- .7 Use concealed fixings throughout installations. Back fix items wherever practical; countersink and plug or fill face fixings to render invisible after installation.

3.4 CONSTRUCTION

- .1 Fastening:
 - .1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
 - .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
 - .3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.
 - .4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .2 Standing and running trim:
 - .1 Install door and window trim in single lengths without splicing.

3.5 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.6 TOUCHUP AND PROTECTION

- .1 Fill and retouch all nicks, chips and scratches in factory finishes and substrate materials to AWS standards. Replace damaged items that cannot be repaired to AWS standards.
- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by finish carpentry installation.
- .4 Leave work to be site finished ready for finishing by Section 09 91 19 – General Painting.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Board insulation for the exterior wall behind the finish.

1.2 REFERENCE STANDARDS

- .1 All Reference Standards are latest editions, unless noted otherwise.
- .2 ASTM C423, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- .3 ASTM D2842, Water Absorption of Rigid Cellular Plastics.
- .4 ASTM E90, Method for Laboratory Measurement of Airborne-Sound Transmission Loss in Building Partitions.
- .5 ASTM E336, Measurement for Airborne Sound Insulation in Buildings.
- .6 ASTM E413, Classification for Rating Sound Insulation.
- .7 CAN/CGA-B149.1, Natural Gas Installation Code.
- .8 CAN/CGA-B149.2, Propane Installation Code.
- .9 CAN/CGSB-51.26, Thermal Insulation, Urethane and Isocyanurate Boards, Faced.
- .10 CAN/CGSB-51.33, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .11 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .12 CAN/CGSB-51.38, Cellular Glass Thermal Insulation.
- .13 CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.
- .14 CAN/CSA-A247, Insulating Fibreboard.
- .15 CSA B111, Wire Nails, Spikes and Staples.
- .16 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .17 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .18 CAN/ULC-S102.2, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
- .19 CAN4-S114, Standard Method of Test for Determination of Non-Combustibility of Building Materials.
- .20 CAN/ULC-S604, Factory-Built, Type A Chimneys.
- .21 CAN/ULC – S770, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

- .22 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .23 CAN/ULC-S702, Standard for Thermal Insulation Mineral Fibre for Buildings.

1.3 SUBMITTALS

- .1 Submit product data and manufacturer's installation instructions of materials under provisions of Section 01 33 00- Submittals.
- .2 Product Data
 - .1 Provide manufacturer's technical data for each type of insulation.
 - .2 Include product characteristics and performance criteria: RSI values (aged values for extruded polystyrene, polyurethane and rigid mineral wool insulations to CAN/ULC-S770 and CAN/ULC-S702, respectively), fire performance characteristics, moisture vapour permeance, water absorption ratings, compressive strengths, sound transmission ratings, evaluation reports showing conformance to applicable codes for extruded polystyrene and rigid mineral wool insulations.
- .3 Samples: Submit 600 x 600 mm samples of exposed insulation for verification of colour.
- .4 Test Reports: Submit copies of fire test reports from ULC or UL of product and assembly indicating conformance to:
 - .1 CAN/ULC-S101 for fire resistance rating.
 - .2 CAN/ULC-S102 and CAN/ULC-S102.2 for surface burning characteristics.
 - .3 CAN/ULC-S114 for noncombustibility.
- .5 Manufacturer's Installation Instructions: Indicate procedures for preparation and installation specific to the work of this section.
- .6 Manufacturer's Certificate: Submit certificate stating that products meet or exceed specified requirements.

1.4 REGULATORY REQUIREMENTS

- .1 Conform to British Columbia Building Code for combustibility flame spread and smoke developed performance requirements of polystyrene insulations.

1.5 MOCK-UPS

- .1 Provide mock-up of insulation under provisions of 01 33 00 - Submittals.
- .2 Mockup insulation for wall cladding assembly of building, to establish construction techniques.
- .3 Locate where directed by Departmental Representative.
- .4 Mockup may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Minimize time insulation products are stored or exposed to sunlight at project site. Keep covered with opaque polyethylene film or light coloured tarpaulins.
- .2 Store products away from construction activity and sources of ignition.
- .3 Protect products from damage during handling, installation and at point of installation.

1.7 AMBIENT CONDITIONS

- .1 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

Part 2 Products

2.1 EXTRUDED POLYSTYRENE BOARD

- .1 Insulation: To CAN/ULC-S701, Type 3, rigid, closed cell type, with integral high density skin.
 - .1 Styrofoam CavityMate by Dow Chemical Canada Inc.
 - .2 Celfort 200 by Owens Corning
 - .3 Or approved alternative
- .2 Thermal Resistance: maximum RSI of 0.87/ 25 mm.
- .3 Board Size: As indicated on drawings.
- .4 Edges: Shiplap

2.2 MINERAL FIBRE BOARD INSULATION

- .1 To CAN/ULC S702 Type 1, rigid type, fibres manufactured from stone.
 - .1 ComfortBoard 1100 Insulation by Rockwool
 - .2 Or approved alternative
- .2 Thermal Resistance: RSI value of 0.70/25 mm.
- .3 Density: 128 kg/m³.
- .4 Edges: Square.
- .5 Flame Spread/Smoke Developed Values: spread classification of 5 or below to CAN/ULC-S102.

2.3 POLYISOCYANURATE INSULATION

- .1 To CAN/ULC S704-11, Type 2, rigid, fibre reinforced, closed cell.
 - .1 Sopra-Iso by Soprema
 - .2 IKOTherm III by IKO Industries Ltd.
 - .3 Energy 3 CGF by Johns Manville.

- .4 Or approved alternative.
- .2 Thermal Resistance: RSI value of 1.00/25 mm.
- .3 Board Size: Maximum panel shall be 1219 mm (48"). Thickness indicated on drawings.
- .4 Water Absorption: In accordance with ASTM D2842.
- .5 Edges: Square. Installed in two layers, minimum with joints staggered 300 mm (12") between layers.
- .6 Facing: Integrally laminated to heavy, non-asphaltic, fiber reinforced, non-organic glass fibre facers.

2.4

ACCESSORIES

- .1 Adhesives:
 - .1 Adhesive: Compatible with insulation and as recommended by insulation and insulation fastener manufacturer for application.
- .2 Protection Board:
 - .1 Premoulded asphalt fibre composition board, 6 mm thick.
- .3 Nails: To CSA B111, galvanized steel, flat head, length to suit insulation plus 25 mm.
- .4 Screws: galvanized steel, hex head, with large diameter nylon, self-drilling, self-tapping, length to suit insulation plus 25 mm.
- .5 Staples: To CSA B111, galvanized steel, 12 mm minimum leg.
- .6 Wood Strapping: As specified in Section 06 10 00 - Rough Carpentry.
- .7 Foamed-in-place insulation: purpose made for closing gaps in thermal insulation layer of extruded polystyrene thermal insulation systems.
 - .1 Enerfoam by Abisko Manufacturing.
 - .2 Or approved alternative.

Part 3

Execution

3.1

EXAMINATION

- .1 Verify that building substrate surfaces, adjacent materials and installation conditions are ready to accept the work of this section. Ensure insulation materials and surfaces are dry.
- .2 Verify that substrate is flat, sound, clean, and free of objectionable air surface voids, fins, irregularities, materials or substances that may impede adhesive bond.
- .3 Notify Departmental Representative upon completion of installation of vapour retarder and air seal to allow review before insulating material is installed or work is obscured.

- .4 Beginning of installation means acceptance of substrate.

3.2 PRE-INSTALLATION MEETING

- .1 Convene a pre-installation meeting one week prior to commencing work of this section, under provisions of Section 01 10 01 – General Requirements.
- .2 Require attendance of parties directly affecting work of this section.
- .3 Review conditions of installation, installation procedures, procedures for inspection and testing, special finish mock-ups and coordination of work with related sections.

3.3 PREPARATION

- .1 Clean substrates of substances harmful to insulation material. Remove projections from that could puncture sheet materials.

3.4 INSTALLATION

- .1 Install materials in accordance with manufacturer's recommendations.
- .2 Install insulation after building substrate materials are dry.
- .3 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .4 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .5 Keep insulation minimum distance required from heat emitting devices such as recessed light fixtures and from sidewalls of CAN4-S604 Type A chimneys and CAN/CGA- B149.1 and CAN/CGA-B149.2, Type B and L vents.
- .6 Use boards of largest possible dimensions to reduce number of joints. Boards with chipped and broken edges are unacceptable.
- .7 Offset both vertical and horizontal joints in multiple layer applications.
- .8 Apply adhesives in accordance with manufacturer's instructions. Attach boards prior to skinning of adhesive.
- .9 Insert fasteners into and compress against surrounding substrates
- .10 Where impale type insulation fasteners are used to adhere to air/vapour barrier membrane, place a 100mm x 100mm (4" x 4") minimum air/vapour barrier membrane patch centred on each pin after fastener is installed.
- .11 Ensure that the integrity of the air/vapour barrier system is maintained. Take extreme care that the systems are sealed where elements penetrate them, and that they extend across and are sealed at junctions between other parts of the barrier system.
- .12 Do not enclose insulation until it has been reviewed by Departmental Representative.

3.5 PERIMETER FOUNDATIONS

- .1 Install boards on exterior face of foundation wall, vertically. Install boards as continuation of exterior wall insulation.
- .2 Place boards in a method to maximize contact with bedding. Stagger side and end joints. Butt edges and ends tight to adjacent boards.
- .3 Extend boards across control and expansion joints, unbonded to foundation 75 mm on one side of joint.
- .4 Cut and fit insulation tight to protrusions or interruptions to insulation plane.
- .5 Immediately following application of board insulation, place protection boards over exposed insulation surfaces. Fasten protection board with insulation fasteners.

3.6 PROTECTION

- .1 Protect insulation under provisions of Section 01 10 01 – General Requirements.
- .2 Do not permit work to be damaged prior to covering insulation. Protect from harmful weather exposures and physical abuse. Place plywood sheeting across exposed edges and corners. Secure temporarily to prevent displacement.
- .3 Provide temporary coverings or enclosures when insulation will be subject to damage and cannot be protected by permanent construction immediately after installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Batt insulation for filling existing roof parapets and roof curbs.

1.2 REFERENCE STANDARDS

- .1 All Reference Standards are latest editions, unless noted otherwise.
- .2 CAN/CGA-B149.1, Natural Gas Installation Code.
- .3 CAN/CGA-B149.2, Propane Installation Code.
- .4 CAN/CGSB-51.33, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .5 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .6 CSA B111, Wire Nails, Spikes and Staples.
- .7 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .8 CAN4-S114, Standard Method of Test for Determination of Non-Combustibility of Building Materials.

1.3 SUBMITTALS

- .1 Submit product data and samples under provisions of Section 01 33 00 – Submittals.
- .2 Product Data
 - .1 Provide manufacturer’s technical data for insulation.
 - .2 Include product characteristics and performance criteria: RSI values, fire performance characteristics, moisture vapour permeance of facings and sizes, and sound transmission ratings.
 - .3 Test Reports: Submit copies of fire test reports from ULC or UL product and assembly indicating conformance to:
 - .1 CAN/ULC-S101 for fire resistance rating.
 - .2 CAN/ULC-S102.2 for surface burning characteristics.
 - .3 CAN/ULC-S114 for non-combustibility

1.4 QUALITY ASSURANCE

- .1 Obtain each type of insulation material from a single manufacturer.

1.5 MOCK-UPS

- .1 Provide mock-up of insulation under provisions of 01 33 00 - Submittals.
- .2 Locate where directed by the Departmental Representative.

- .3 Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Store products away from construction activity and sources of ignition.
- .2 Protect products from damage during handling, installation and at point of installation.

Part 2 Products

2.1 MINERAL FIBRE BATT INSULATION

- .1 To CAN/ULC S102.2, Type 1, Class C, friction fit, fibres manufactured from rock or glass.
 - .1 Flexi by Rockwool
 - .2 EcoTouch Pink by Owens Corning.
 - .3 Or approved alternative.
- .2 Thermal Resistance: RSI value to be minimum of 0.69/25 mm.
- .3 Size: As indicated on drawings.
- .4 Density: 32 kg/m³.
- .5 Facing: Unfaced.
- .6 Flame Spread/Smoke Developed Values: 0 to CAN/ULC-S102.
- .7 Combustibility: Noncombustible to CAN/ULC-S114.

2.2 ACCESSORIES

- .1 Retaining Mesh: Galvanized steel, hexagonal wire mesh.
- .2 Insulation Fasteners: Impale type, galvanized steel, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that building substrate surfaces, adjacent materials and installation conditions are ready to accept the work of this section. Ensure insulation materials and surfaces are dry.
- .2 Notify Departmental Representative upon completion of installation of insulating material to allow review before vapour retarder is installed or work is obscured.
- .3 Beginning of installation means acceptance of existing surfaces.

3.2 PRE-INSTALLATION MEETING

- .1 Convene a pre-installation meeting one week prior to commencing work of this section, under provisions of Section 01 10 01 – General Requirements.
- .2 Require attendance of parties directly affecting work of this section.
- .3 Review conditions of installation, installation procedures, procedures for inspection and testing, and coordination of work with related sections.

3.3 INSTALLATION

- .1 Install insulation in accordance with manufacturer's instructions.
- .2 Install insulation to maintain continuity of thermal protection of building elements and spaces.
- .3 Install in exterior parapet spaces without gaps or voids. Do not compress insulation.
- .4 Inspect existing installations and make good where either deficient or missing (at external corners in particular).
- .5 Trim insulation neatly to fit spaces. Insulate miscellaneous gaps or voids. Fit tight to exterior side of mechanical and electrical services within plane of insulation.
- .6 Install friction fit insulation tight to framing members and in full contact with sheathing. Completely fill prepared spaces.
- .7 Keep insulation minimum 75 mm from light fixtures and heat emitting devices, 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.
- .8 Install and coordinate installation of air seals in accordance with Section 07 65 16 – Self-Adhering Membrane.

3.4 PROTECTION

- .1 Protect insulation.
- .2 Do not permit work to be damaged prior to covering insulation. Protect from harmful weather exposures and physical abuse.
- .3 Provide temporary coverings or enclosures when insulation will be subject to damage and cannot be protected by permanent construction immediately after installation.

3.5 SCHEDULES

- .1 Parapet and Roof Curb Insulation: RSI 3.5 mineral fibre batt, unfaced.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Work included as part of insulation for roof penetrations.

1.2 REFERENCE STANDARDS

- .1 CAN/ULC S705.1, Thermal Insulation, Urethane, Spray in Place.
- .2 CAN/ULC S705.2, Manual for Installers of Spray Urethane Foam Thermal Insulation.
- .3 CAN/ULC S718, Site Quality Assurance Program for Spray Applied Polyurethane Foam Insulation.
- .4 CAN/ULC-S770, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
- .5 Canadian Urethane Foam Contractors Association (CUFCA), Manual for Installation of Spray Polyurethane Foam Thermal Insulation.
- .6 CCMC Technical Manual #07272
- .7 ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- .8 ASTM D1621, Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.
- .9 ASTM D2856, Standard Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer.
- .10 ASTM E84. Standard Test Method for Surface Burning Characteristics of Building Materials.
- .11 CAN/ULC – S102M , CAN/ULC-S102 Surface Burning Characteristics of Building Materials and Assemblies

1.3 QUALITY ASSURANCE

- .1 Applicator performing work under this section shall be licensed under the Canadian Urethane Foam Contractors Association (CUFCA) Quality Assurance Program or equivalent third-party quality assurance program acceptable to the Departmental Representative.
- .2 Applicator personnel performing work under this section shall be trained by and certified under the CUFCA or equivalent third-party quality assurance program acceptable to the Departmental Representative. These certified individuals must have their certification cards in their possession and available for presentation upon request. In instances where the specification calls for the foam to be part of the air barrier system, the CUFCA or equivalent third-party quality assurance program qualification card of the applicator shall bear both a polyurethane foam applicator number and a certified air barrier system applicator number.

- .3 Applicators performing work under this section shall have a minimum of three years of documented experience in the application of spray-applied foam insulation.
- .4 Spray applied insulation shall meet requirements of authorities having jurisdiction.
- .5 Use materials, application equipment and application techniques approved by material manufacturer.
- .6 Keep a copy of the manufacturer and CUFCA, or equivalent third-party quality assurance program installation manual or guide for the application of spray polyurethane foam on site. In cases of transition membrane installation, a copy of the manufacturer's installation manual or guide shall be kept on site.

1.4 SUBMITTALS

- .1 Submit product literature, application procedures, Materials Safety Data Sheets (MSDS) and certified test reports indicating conformance to specified requirements. Submit proof of license and certification.
- .2 Submit CCMC testing to Technical Manual #07272 showing system with transition membranes meets air barrier requirements.
- .3 Submit written confirmation stating that all surfaces have been inspected and approved for application of materials specified.
- .4 Submit 300mm (12") square sample of finished product.

1.5 MOCK-UP

- .1 Upon request and prior to commencement of the work, apply spray polyurethane insulation of thickness required to meet specified thermal value to a minimum of five square metres (54 square feet) minimum, showing both inner and outer corners of a pre-selected area of wall.
- .2 Locate mock-up where directed by Departmental Representative.
- .3 Conduct following trials on mock-up as required by the CUFCA or equivalent third-party quality assurance program acceptable to the Departmental Representative:
 - .1 Verify the core density.
 - .2 Verify adhesion between transition membrane and the substrate.
 - .3 Verify cohesion/adhesion between the insulation material and the substrate.
 - .4 Ensure the results are in compliance and enter them in the CUFCA or equivalent third-party quality assurance program daily report.
- .4 Allow for Departmental Representative's review of mock-up before proceeding with work.
- .5 Modify the mock-up at no additional cost to the contract as may be required to meet specified requirements.

- .6 Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in their original packaging in undamaged condition, sealed with labels intact, having manufacturer's name, brand, weight, CSA, CCMC numbers, expiry date on containers and other references to accepted standards clearly shown.
- .2 Decontaminate empty containers of isocyanates and remove from the work site daily, in a safe and legal manner.

1.7 AMBIENT CONDITIONS

- .1 Ensure work area is adequately ventilated.
- .2 Do not spray apply foam insulation when substrate and ambient air temperatures and humidity limits are above or below manufacturer's recommended ranges.

1.8 WARRANTY

- .1 Warrant work performed under this section against defects in workmanship or material for the warranty period indicated in Section 01 78 36 – Warranties and Bonds.
- .2 Promptly rectify, at the Contractor's expense, defects or deficiencies which become apparent during the warranty period.
- .3 Work of this section shall be covered by the third party warranty provided under the manufacturer's Quality Assurance Program.
- .4 Provide a written warranty confirming above, issued on corporate letterhead, signed and sealed by an authorized signing officer.
- .5 Nothing contained in this article shall be construed as in any way restricting or limiting the liability in common law and statutory liability of the Contractor.

Part 2 Products

2.1 SPRAY FOAM INSULATION

- .1 Spray-Applied Polyurethane Foam Insulation: ULC certified sprayed/frothed rigid closed cell foam to CAN/ULC S705.1 with properties indicated below and meeting National Research Council (NRC) requirements for a type III air barrier.

Property	Test Method	Requirement
Density	ASTM D1622	30 kg/m ³ (1.8 lb/ft ³)
Compressive strength	ASTM D1621-94	170 kPa (25 psi) min.
Tensile Strength	ASTM D1623-78	300 kPa min.
Closed cell content	ASTM D2856	90% min.
Dimensional stability	ASTM D2126	+9.8% max. @ 70C, R.H. @ 97>+/-3%
Water absorption (% volume)	ASTM D2842	0.8% max.
Water vapor permeance (core), 50 mm	ASTM E96	57 ng/(Pa.s.m ²) max. (1 perm)
Air leakage	ASTM E283	0.02 L/s/m ² @ 75Pa
Long Term Thermal Resistance	CAN/ULC-S770	1.8 R.S.I./50 mm min.
Flame Spread	CAN/ULC-S102/S127	500 max.

- .2 Approved Products:

- .1 Heatlok Soya HFO by Demilec Inc.
- .2 Polarfoam 7300-00 Soya HFO by Demilec Inc.
- .3 Walltite CM01 by BASF Canada.
- .4 Or approved alternative.

2.2 TRANSITION MEMBRANE

- .1 Refer to Section 07 65 16 – Self-Adhering Membrane.

2.3 ACCESSORIES

- .1 Primer: to CUFCA or equivalent third-party quality assurance program technical manual and manufacturer’s requirements.
- .2 Thermal Barrier: Grace Monokote Z-3306 per manufacturer’s specifications or as recommended by spray foam manufacturer or distributor.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect areas to receive work of this Section and ensure conditions are suitable to begin application.
- .2 Examine substrates and immediately inform Departmental Representative in writing of defects.
- .3 Ensure that all work penetrating through air seal is complete.
- .4 Ensure that appropriate back-up material has been installed in all large voids.

3.2 PRE-INSTALLATION MEETING

- .1 Convene one weeks prior to commencing work of this section, under provisions of Section 01 33 00 – Submittals.

3.3 PREPARATION

- .1 Prepare surfaces in strict accordance with manufacturer's requirements.
- .2 Apply foam insulation primer, when required, to properly prepared substrates in strict accordance with manufacturer's guidelines so as to achieve minimum dry film thicknesses required and allow to cure.
- .3 Ensure that all contact surfaces and environmental conditions meet manufacturer's suitability requirements prior to commencing work.
- .4 Surfaces to be covered with foam shall be clean and dry, as required by CAN/ULC-S705.2.
- .5 Check metallic surfaces to ensure no oxidation has occurred. Use primer if necessary. Refer to CUFCA or equivalent third-party quality assurance program manual.
- .6 During spraying operations, provide and maintain masking, drop cloths and other appropriate covering to protect all adjacent exposed surfaces from overspray.
- .7 Perform on-site testing, including but not limited to the following:
- .8 Carry out density and adhesion tests as a minimum, daily on both core density and cohesion/adhesion to the substrate and in accordance with CUFCA or equivalent third-party quality assurance program guidelines. Enter results of these tests in the daily report forms provided by CUFCA or equivalent third-party quality assurance program.
- .9 Once the curing time required by the transition membrane manufacturer has elapsed, conduct a test to verify adhesion between the membrane and the substrate. Perform all adhesion tests using methods recommended by foam manufacturer.
- .10 Perform adhesion tests on all corners and building angles, as well as at wall/slab intersections. Perform one test per 30m (100ft.) length of wall. Repeat this procedure for wall/roof intersections.

- .11 Verify adhesion of the transition membrane at perimeters of openings at the rate of 15% for projects with more than ten openings, and 30% for projects with less than ten openings.
- .12 Perform adhesion tests on the transition membranes at every tenth column or beam.
- .13 Adhesion tests are not required if the membrane is mechanically fastened.

3.4 TRANSITION MEMBRANE

- .1 Provide transition membrane as recommended in foam manufacturers written recommendations and in areas shown on the drawings.

3.5 APPLICATION

- .1 Conform to standards noted in latest printed installation requirements of approved spray applied foam insulation manufacturer using specially designed machines and nozzles as CAN/ULC S705.2 and as approved by the insulation manufacturer.
- .2 Spray apply foam insulation to a total spray resistance value as stated on drawings with maximum variation of indicated or required thickness of not more than 6mm (1/4”).
- .3 Provide continuous gusset profiled seal at wall/decking junctures, extending 150 mm vertically and horizontally from juncture. Ensure application leaves no voids.
- .4 Finished surface of spray applied foam insulation shall be free of voids and embedded foreign objects.
- .5 Do not enclose insulation until it has been reviewed by Departmental Representative.

3.6 CLEAN-UP

- .1 Upon completion of work of this Section and immediately after foam surface has hardened, remove all overspray, debris, waste, droppings and the like from floors, walls and all other adjacent surfaces and legally dispose of refuse.
- .2 Ensure cleaning methods do not damage work performed under this section or work of other sections.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Air/vapour barrier membrane in exterior wall and roof construction where indicated on drawings.

1.2 SUBMITTALS

- .1 Product Data: Provide data on material characteristics, performance criteria, and limitations.
- .2 Manufacturer's Installation Instructions: Indicate preparation, installation requirements and techniques, product storage and handling criteria.

1.3 QUALITY ASSURANCE

- .1 Obtain material from a single manufacturer.
- .2 Work of this section shall be carried out by a specialist applicator, who is approved or licenced by the membrane manufacturer, who can substantiate successful recent installation of similar membrane systems over a minimum of five years. Submit evidence of experience and membrane manufacturer's approval upon request.
- .3 Provide for a technical representative from the membrane manufacturer to be on the job site to assure ensure compliance with the manufacturer's directions. The technical representative shall be present when the applications starts and shall make periodic inspections during applications, as required. The technical representative shall confirm such inspections have been made by submitting written reports to the Departmental Representative on the membrane application and percentage completion within 5 five days of after each site visit.

1.4 MOCK-UP

- .1 Provide mock-up of air barrier materials under provisions of Section 01 33 00 - Submittals.
- .2 Construct typical exterior wall, 3.0 m long by 3.0 m wide, incorporating window and door frame and sill, insulation, building corner condition, and junction with roof vapour retarder, illustrating materials interface and seals.
- .3 Locate where directed by the Departmental Representative.
- .4 Allow for review of mock-up by the Departmental Representative before proceeding with air barrier work.
- .5 Mock-up may not remain as part of the Work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in their original packaging in undamaged condition, sealed, with labels intact, and having manufacturer's name, brand, weight, CSA and other references to accepted standards clearly shown.
- .2 Deliver material as required for installation and keep site storage to a minimum.

- .3 Protect materials from damage, weather and store in a dry place.
- .4 Handle materials and equipment in strict accordance with the manufacturer's recommendations. Remove damaged or deteriorated materials from site.

1.6 AMBIENT CONDITIONS

- .1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.
- .2 Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation. Check surfaces and areas specified and shown to receive membrane.

Part 2 Products

2.1 MODIFIED BITUMINOUS SHEET AIR/VAPOUR BARRIER (SELF-ADHERED)

- .1 Self-adhering composite SBS rubberized asphalt based membrane providing a continuous air and vapour seal. Acceptable products include:
 - .1 Sopraseal Stick 1100 T by Soprema.
 - .2 Blueskin SA by Henry Company
 - .3 AquaBarrier AVB by IKO Industries Ltd.
 - .4 Or approved alternative.

2.2 ACCESSORIES

- .1 Primers, mastics, sealants, liquid membrane, control joint materials, etc.: As required for complete air barrier membrane system installation in accordance with membrane manufacturer's standards.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that surfaces and conditions are ready to accept the Work of this section.
- .2 Report any unsatisfactory conditions or surfaces to the Departmental Representative in writing. Starting work shall imply acceptance of surfaces and conditions.
- .3 Notify the Departmental Representative of any variations beyond the accepted tolerances in the substrate or in the adjacent work.

3.2 PRE-INSTALLATION MEETING

- .1 Convene one week prior to commencing work of this section, under provisions of Section 01 10 01 – General Requirements.

3.3 PREPARATION

- .1 Prepare surfaces to receive air barrier membrane, including substrates, joints, cracks, and coves, in accordance with the manufacturer's directions.
- .2 Ensure that substrate surfaces are smooth, dry and firm. Remove any frost, ice, loose particles, ridges, laitance, cracks, grease, asphalt, oil and other foreign matter which could prevent adhesion of the membrane to the substrate.
- .3 Sequence work to provide continuity of air/vapour barrier with shingle lapping.

3.4 PRIMING

- .1 Clean and prime substrate surfaces to receive sheet, adhesive and sealants in accordance with manufacturer's directions.
- .2 Prime all surfaces to receive self-adhering membrane at the rate recommended by the manufacturer. Apply primer uniformly.
- .3 Allow primer to dry for minimum 30 minutes before installation of self-adhering membrane. Re-prime primed surfaces not covered by membrane during the same working day.

3.5 MEMBRANE APPLICATION

- .1 Lay out the work accurately to fit the site conditions and adjacent work.
- .2 Apply membrane in accordance with manufacturer's written directions, including temperature limitations, curing requirements and all other application procedures.
- .3 Coordinate proper construction of interface junctions so as to maintain continuity of the air/vapour barrier. Install the air/vapour barrier to create a continuous seal at foundations, roofs and walls, and at junctures of different materials or construction types.
- .4 Cut and seal air barrier membrane around protrusions to form tight air seal.
- .5 Apply trowelled bead of mastic to all terminations at end of each day's work.
- .6 Inspect membrane thoroughly before covering and make any necessary corrections. Repair misaligned or inadequately capped seams, punctures, or other damage by patching and sealing in accordance with membrane manufacturer's directions.
- .7 Ensure continuity of the air/vapour barrier as detailed.
- .8 Apply membrane in a "shingle" fashion.
- .9 Reinforce all corners with second ply of membrane.
- .10 Extend all membrane patches a minimum 150 mm (6") in all directions from the limit of the deficiency repair location or penetration. Seal all around patches with tooled mastic
- .11 Install an additional strip of membrane over horizontal support (sub-girts etc.) fasteners penetrating membrane. Extend membrane minimum 50 mm (2") each direction around fastener.

- .12 Seal all side laps and all top laps with mastic.
- .13 Fill all joints or gaps wider than 6mm (1/4") with galvanized steel sheet, wood or other suitable backing where the membrane is unsupported across these gaps. Apply 300mm (12") strip of membrane over joints prior to application of the field membrane.
- .14 Coordinate installation of membrane with other related work, such as insulation, to minimize exposure of membrane.

3.6 CLEANING AND PROTECTION

- .1 Repair, remove and clean all smears on exposed finished surfaces or surfaces to be subsequently finished. Clean off immediately as directed by and to the satisfaction of the Departmental Representative.
- .2 Protect all adjacent surfaces from the Work of this section.
- .3 As work proceeds and upon completion, clean up and remove from the premises all rubbish and surplus materials resulting from this Work.
- .4 Ensure that any membrane that is installed in a high traffic area is protected from damage.
- .5 Prior to covering the membrane, notify the Departmental Representative in writing that the membrane installation has been inspected by the manufacturer's representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Furnish all materials, labour, equipment and services, necessary for the detailed design, erection, drawings, shop drawings, fabrication and erection of the complete panel system.

1.2 REFERENCE STANDARDS

- .1 British Columbia Wall and Ceiling Association (BCWCA)
- .2 ASTM C1186-08– Standard Specification for Flat Fibre-Cement Sheets

1.3 QUALITY ASSURANCE

- .1 Use experienced installers approved by the manufacturer.
- .2 Use only skilled trades people experienced in type and class of work.
- .3 Manufacturer’s representative shall:
 - .1 Review installation methods.
 - .2 Provide technical assistance as required to ensure sound installation.

1.4 SUBMITTALS

- .1 Product Data: Submit duplicate copies of specifications, installation data, and other pertinent manufacturer’s literature.
- .2 Samples: Submit duplicate 150mm x 150mm samples of panel materials, of texture, colour and profile specified.
- .3 Shop Drawings:
 - .1 Indicate dimensions, panel sizes, profiles, attachment placement, frequency and methods of attachment, trim and closure pieces, metal furring and related work for all elevations.
 - .2 Shop Drawings shall be signed and sealed by a professional engineer licensed to practice structural engineering at the Place of the Work, familiar with panels, components and systems. Indicate design loads on submitted Shop Drawings.
 - .3 The professional engineer signing and sealing the Shop Drawings shall submit the required documentation covering the specified work and conduct field inspections as required to ensure the work is performed in accordance with the Shop Drawings.
 - .4 Do not fabricate any work until the Departmental Representative has reviewed the Shop Drawings and samples.

1.5 MOCK-UP

- .1 Assemble a full-size mock-up of system on site. The Departmental Representative will determine the exact number of panels and area for assembly. Include all components of the system, including typical joints and connection hardware, and typical tie-ins to adjoining systems, all finished as specified.
- .2 Modify the mock-up as required to meet specified design criteria and performance requirements.
- .3 Allow for Departmental Representative's review of mock-up before proceeding with the work.
- .4 Mock-up may be part of finished work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store material in accordance with manufacturer's directions.
- .2 Ensure materials are not exposed to wetting or damage. Store neatly, and properly stacked on a smooth, level surface.
- .3 Remove from site all materials that are stained, watermarked, cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Protect finish and edges in accordance with manufacturer's directions.
- .5 Provide Manufacturer's standard material warranty

Part 2 Products

2.1 DESIGN RESPONSIBILITY

- .1 The design, fabrication and erection of the panels as required to meet these specifications shall be the complete responsibility of the Contractor.
- .2 Design responsibility includes but is not necessarily limited to, the design and sizing of all panels, connection hardware including supporting track members, all anchors, fasteners, clips and girts as required for the proper anchorage of the panels to the building structure. Design connection hardware to be compatible with the panel system.
- .3 The panel details shown on the Drawings are for the purpose of indicating the preferred profiles and dimensions necessary to achieve the design intent and are not intended to eliminate other designs. Minimal dimension adjustments to that shown may be made in the interest of fabrication or erection methods or techniques, weatherability, or satisfying the design criteria and performance requirements specified, provided that the design intent is maintained.

2.2 DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS

- .1 The system including required stiffeners and connection hardware shall meet the Building Code requirements for wind loading and thermal movements.

- .2 Design panels, connection and attachment hardware, suspension systems and fasteners to accommodate expansion and contraction.
- .3 Design connection and attachment hardware so as to not cause staining of panels or other adjoining materials.
- .4 Labels and trademarks, including applied labels, shall not be visible on the finished work.
- .5 There shall be no warping or buckling of panel faces, including when panels are under full design loads.
- .6 Design and install panel system to allow for free and noiseless vertical and horizontal movement due to thermal contraction and expansion of all component parts, and .to avoid buckling, opening of joints, undue stress on fasteners, failure of sealants and any other detrimental effects.
- .7 Limit the deflection of the components of the system as required to prevent any adverse effects on the watertight integrity of the system or on any system component.

2.3 PANELS

- .1 Glass fibre reinforced concrete panels.
 - .1 Produced of mineral raw materials
 - .2 Size: As shown on drawings.
 - .3 Texture: standard or approved by Departmental Representative.
 - .4 Reinforcement by AR (alkaline-resistant) glassfibre reinforced as glass-fibre-reinforced strands and short fibres in the matrix
 - .5 Production method by extrusion
 - .6 Weight approx. 26-31.5kg/m²
 - .7 Thickness 13 mm
 - .8 Bending tension resilience minimum 18 N/mm²
 - .9 Elasticity modulus minimum 10,000N/mm²
 - .10 Frost resistance pursuant to EN 12467 or equivalent.
 - .11 Building material class A1 not flammable pursuant to DIN 4102 | EN 13501 or equivalent.
 - .12 Water impermeability pursuant to EN 12467 or equivalent
 - .13 Wet-dry test pursuant to EN 12467 or equivalent
 - .14 Crystalline silica < 0% (not detectable)
 - .15 Surface protection: Manufacturer applied transparent hydrophobic coating.
- .2 Or approved alternative.

2.4 TRIM BOARDS AND MOULDING

- .1 Non-asbestos fibre-cement board, to ASTM C1186, Grade II, Type A. ASTM E136, non-combustible material. ASTM E84, Flame Spread Index of 0.
 - .1 Or approved alternative.
- .2 Prime Coating: As recommended by the Manufacturer.
- .3 Finish Coating: Refer to Section 09 91 19 – General Painting

2.5 ACCESSORIES

- .1 Fasteners: to CSA B111. Purpose made stainless steel or hot-dipped galvanized nails. Nail head diameter of not less than 4.8mm and shank thickness of not less than 2.0mm, with sufficient length to penetrate 19mm into substrate.
- .2 Joints: Treat all butted joints with PVC H MOLD strips. Colour to match panel.
- .3 Sealants: per Section 07 92 00 – Building Envelope Sealants.

Part 3 Execution

3.1 PREPARATION

- .1 Inspect substrate prior to installation of product. Report any unsatisfactory conditions to the Departmental Representative. Installation of panel materials implies acceptance of the substrate.
- .2 Examine and obtain all necessary measurements of previously executed work which may affect the work to this section.
- .3 Report any discovered discrepancies to the Departmental Representative.

3.2 TRIM AND MOULDING INSTALLATION

- .1 Install trim and mouldings in strict accordance with the manufacturer's written instructions and reviewed Shop Drawings.
- .2 Fasten through trim into structural substrate.
- .3 Place fasteners no closer than 19mm ($\frac{3}{4}$ ") and no further than 50mm (2") from side edge of trim board and no closer than 25mm (1") from end. Fasten maximum 400mm (16") on center and in accordance with reviewed Shop Drawings.
- .4 Maintain clearance between trim and adjacent finished grade.
- .5 Trim inside corner with single board.
- .6 Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten trim board to trim board.
- .7 Allow 3mm ($\frac{1}{8}$ ") gap between trim and cladding.
- .8 Seal gap with caulking.

3.3 PANEL INSTALLATION

- .1 Install panels in strict accordance with the manufacturer's written instructions and reviewed Shop Drawings.
- .2 Install blocking where horizontal panel joints occur.
- .3 Place fasteners no closer than 9.5mm (3/8") from panel edges and 50mm (2") from panel corners.
- .4 Maintain clearance between panel and adjacent finished grade.

3.4 CLEANING AND TOUCH-UP

- .1 Install sealants around windows and doors, etc. prior to finish painting.
- .2 Remove any grime and dirt from the cladding. Patch all hammer dents, holes or chipped edges with exterior masonry spackling prior to finish painting.
- .3 Replace any cracked or broken trim or cladding boards.
- .4 At completion of the work, remove any excess materials, debris and equipment from the site.

END OF SECTION

Part 1 General

1.0 SECTION INCLUDES

- .1 Preformed metal wall panels.
- .2 All necessary connection hardware and supporting members for attachment of the metal panels to the exterior backup walls, including brackets, clips, and channels.

1.1 REFERENCE STANDARDS

- .1 BC Building Code
- .2 CAN/CSA –S136 for the Design of Cold Formed Steel Structural Members.
- .3 CSSBI B14, Sheet Steel Roofing and Siding Installation Guide.
- .4 CSSBI B16, Prefinished Sheet Steel for Building Construction.
- .5 CSSBI 20M, Sheet Steel Cladding for Architectural and Industrial Applications.
- .6 Architectural Sheet Metal Manual, SMACNA

1.2 QUALITY ASSURANCE

- .1 Metal panel manufacturer shall have complete in-house production facilities and a minimum of at least ten years recent experience in manufacturing preformed architectural metal wall panel systems.
- .2 Installer shall be approved by panel manufacturer and have a minimum of at least five years recent experience in satisfactory installation of preformed architectural metal wall panel systems.

1.3 DEFINITIONS

- .1 The term “dry joint system” where used in this section means a metal panel system supported on an anchorage system which is based on the rainscreen principle and does not require sealing of exterior joints between panels to be watertight.

1.4 SUBMITTALS

- .1 Shop Drawings:
 - .1 Incorporate plans, all elevations, sections and full size details for all work of this section. Include panel sizes, bow, camber and squareness tolerances. Provide full-size details showing and specifying all metal thicknesses, types and finishes; direction and magnitude of thermal expansion; type of construction including joinery, fasteners and welds; all anchorage assemblies, connections and components; and fabrication and erection tolerances.
 - .2 Do not fabricate any work until the Shop Drawings and samples have been reviewed by the Departmental Representative. Schedule and coordinate

- submittals and their review to expedite the start of fabrication and allow work to progress in accordance with the construction schedule.
- .3 Shop drawings shall be sealed by a professional engineer licenced to practice structural engineering at the Place of the Work.
 - .4 Indicate design loads on submitted Shop Drawings.
 - .5 The engineer who sealed the Shop Drawings shall provide periodic field review of the installation and shall provide sufficient reviews to provide a letter of professional assurance to verify compliance of the system with the Shop Drawings. Submit inspection reports of field reviews within 48 hours.
- .2 Tests and Reports:
- .1 Testing shall be completed by an accredited testing laboratory.
 - .2 Submit copies of panel fabricator's current "System Testing" to ASTM E331 and ASTM E283 for air/water infiltration.
 - .3 Submit two copies of the manufacturer's literature.
 - .4 Submit engineering properties of composite material including weight, bond strength to ASTM C-272 and peel strength to ASTM D1781.
 - .5 Submit test reports showing compliance with specified provisions. If not previously tested, fabricator shall have system tested and shall furnish necessary reports before final review of Shop Drawings.
- .3 Letters of Assurance: The Registered Professional Engineer who signed and sealed the shop drawings shall perform sufficient field reviews in order to provide a letter of professional assurance after completion of the Work, giving assurance that the Work has been fabricated and installed in general conformance with the sealed shop drawings. Approved forms are BC Building Code Letters of Assurance (Schedule C). Written inspection reports of field reviews shall be submitted promptly as the field reviews are made.
- .4 Samples: Submit duplicate colour samples of metal panel finish for colour selection by Departmental Representative. Submit duplicate samples of the panels with selected finish for final approval by Departmental Representative.
- .5 Sample Panels: Submit sample of preformed metal panel, approximately 600 mm x 600 mm square, showing typical connection hardware, fastening method and finish.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Ensure materials are not exposed to wetting or damage. Store neatly, properly stacked.
- .2 Remove from site all panels or components that are stained, watermarked, cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.

- .3 Protect finish and edges in accordance with the metal cladding panel manufacturer's directions.
- .4 Store material in accordance with the panel manufacturer's directions.

1.6 MOCK-UP

- .1 Assemble a full-size mock-up of preformed metal wall panel system on site.
- .2 Departmental Representative will determine exact number of panels and location for mock-up.
- .3 Include all components of the system, including typical joints and connection hardware, and typical tie-ins to adjoining systems, all finished as specified.
- .4 Modify the mock-up as required to meet specified design criteria and performance requirements.
- .5 Mock-up may remain as finished part of the work.

1.7 WARRANTY

- .1 The work included in this section shall be fully warranted by the Contractor in accordance with the requirements of the General Conditions of the Contract and the following additional requirements for a period of not less than five (5) years from the date of Substantial Performance of the Work.
 - .1 Panels: Warranty against oil canning or buckling.
 - .2 Panel Finish: Warranty against the following:
 - .1 Excessive Non-uniformity: Any non-uniform fading during warranty period. Excessive will be determined as a gloss range greater than the samples as approved by the Departmental Representative.
 - .2 Pitting or Corrosion: There shall be no pitting or other type of corrosion.

Part 2 Products

2.1 DESIGN RESPONSIBILITY

- .1 The design, fabrication and erection of the metal siding as required to meet these specifications shall be the complete responsibility of the Contractor.
- .2 Design responsibility includes but is not necessarily limited to, the design and sizing of all metal panels, connection hardware including supporting track members, all anchors, fasteners, clips and girts as required for the proper anchorage of the panels to the building structure. Design connection hardware to be compatible with preformed metal panel system.

- .3 The metal panel details shown on the Drawings are included to indicate the preferred profiles and dimensions necessary to achieve the design intent and are not intended to eliminate other designs. Minimal dimension adjustments to that shown may be made in the interest of fabrication or erection methods or techniques, weatherability, or satisfying the design criteria and performance requirements specified, provided that the design intent is maintained.
- .4 The connection details and attachment hardware shown on the Drawings are diagrammatic only, to indicate the preferred dimensions. They are not intended to eliminate other connection details or hardware attachment methods.

2.2 DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS

- .1 Design the panel system, including required stiffeners and connection hardware, to meet the specified requirements for wind loading, air infiltration and exfiltration and water penetration.
- .2 Design the anchorage system so that the panels are secure yet “free floating”, to accommodate expansion and contraction.
- .3 Design system to provide a dry route and return rainscreen system that includes complete perimeter extrusions along with guttered horizontal members. Provide drainage to the exterior face of wall for any leakage of water occurring at the joints or condensation taking place within the construction. System shall not depend on caulking for watertightness. No continuous edge grip system is acceptable. System shall comply with the following tests.
 - .1 Air Infiltration: When tested in accordance with ASTM E283, air infiltration at 6.24 psf shall not exceed 0.06 cfm/ft² of wall area.
 - .2 Water Infiltration: There shall be no uncontrolled water penetration with ASTM E331 at a differential static pressure of 10 lbs after 15 minutes of testing.
 - .3 Reference velocity pressure shall be 1 in 10.
- .4 Design the supporting anchorage hardware for “dry joint system” with an internal drainage system to catch condensation within the wall and direct it to designated weepage points.
- .5 Design cladding panels to sizes indicated, with joint between panels as detailed. No wet or caulked joints are allowed in the system, other than at tie-ins to adjoining systems.
- .6 Conceal all fastenings and connectors.

- .7 Design panels, connection and attachment hardware, suspension systems and fasteners to accommodate expansion and contraction.
- .8 Design system to accommodate differential slab deflection, lateral interstorey drift and seismic restraint as follows:
 - .1 Interior storey drift under seismic conditions in accordance with NBC 2015
 - .2 Seismic restraint requirements in effect at the Place of the Work.
- .9 Design connection and attachment hardware so as to not cause staining of panels or other adjoining materials.
- .10 Labels and trademarks, including applied labels, shall not be visible on the finished work.
- .11 Design and install system so there is no oil canning, warping or buckling of panel faces, or any other detrimental effects including when panels are under full design loads. Provide any necessary stiffeners within panels to maintain flat panel surface and prevent oil canning.
- .12 Design and install panel system to allow for free and noiseless vertical and horizontal movement, due to the thermal contraction and expansion of all component parts, for an ambient temperature range of from -18°C to $+60^{\circ}\text{C}$. Take into account the ambient temperature range at the time of fabrication, assembly and erection.
- .13 Limit the deflection of the components of the panel system as required to prevent any adverse effects on the watertight integrity of the system assembly or on any related component.

2.3 SINGLE SKIN SHEET STEEL PANELS

- .1 Prefinished galvanized sheet steel panels shaped to profile indicated. Approved system noted below:
 - .1 CLby Vic West Inc.
 - .2 Corrugated cladding by Mercury Metals Inc.
- .2 Base Metal: galvanized steel sheet meeting requirements of ASTM A446, Grade A, zinc coating designation of Z275.
- .3 Minimum Panel Thickness: 0.71mm / 24 gauge.
- .4 Panel sizes and shapes as indicated on Drawings. Overall panel thickness as required to meet specified design criteria and performance requirements.

- .5 Panel Finish:
 - .1 Exposed surfaces of preformed metal panels and associated flashings and trim shall have Series 5000
 - .2 Colour: as selected by the Departmental Representative.
- .6 All panels shall be free of scratches and blemishes. All exposed surfaces of panels shall have factory-applied removable protective film. Film is to remain in place until the work of this section is complete.
- .7 System Components: Panel system shall be a dry-joint rainscreen system comprised of:
 - .1 Fasteners: concealed and non-corrosive.
 - .2 Accessory Components, Flashings and Trim: Factory fabricated, ready for field assembly, of same material and same finish as metal panels.
- .8 Insulation: As specified in Section 07 21 13 - Board Insulation.
- .9 Air/Vapour Barrier: As specified in Section 07 65 16 – Self Adhering Membrane.

2.4 FABRICATION AND MANUFACTURE

- .1 Fabricate panels in accordance with reviewed Shop Drawings.
- .2 Provide all openings and cut-outs complete with matching panel trim around openings for wall penetrations.
- .3 Fabricate and assemble the work of this section with provision for thermal expansion and contraction, fabrication and installation tolerances, and adjoining building component tolerances and design criteria.
- .4 All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, indentations, waves or flaws of any nature impairing strength or appearance; fitted with proper joints and intersections and with specified finish.

Part 3 Execution

3.1 ERECTION

- .1 Erection work shall be carried out by the manufacturer's trained erection crews or manufacturer's approved erector, all in accordance with reviewed Shop Drawings, manufacturer's specifications and the Drawings and Specifications.
- .2 Erect preformed metal wall panel systems in their correct locations, plumb, true, square and level, and in proper alignment with other work and in relation to established lines and to elevations as shown on reviewed Shop Drawings.

- .3 Install all connection hardware and attachments, clips and anchors, securely fastened to surrounding construction, spaced to afford maximum rigidity.
- .4 The surface of all aluminum coming into contact with concrete or steel shall receive a full bodied coat of a Departmental Representative approved bitumastic paint. Take care to keep this paint off all exposed surfaces.
- .5 Provide all holes for penetrations. Provide flashings and return legs around penetrations

3.2 ERECTION TOLERANCES

- .1 Maximum offset from true alignment between two abutting panels: 0.8 mm.
- .2 Make allowances for the cumulative effect of all fabrication, assembly, thermal and erection tolerances.

3.3 CLEANING

- .1 Remove and replace any damaged metal panels.
- .2 Immediately clean off all smears and marks caused during panel erection.
- .3 Upon completion of the work of this section, remove factory-applied protective coverings from exposed surfaces, and clean surfaces free of all smears, marks and discolouration. Perform cleaning in accordance with panel manufacturer's instructions, using cleaning materials acceptable to the manufacturer; if in doubt, make spot tests.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Provide the necessary labour and materials to remove and replace the complete roofing system, sheet metal flashings, down to the structural deck.

1.2 REFERENCE STANDARDS

- .1 All Reference Standards are latest editions, unless noted otherwise.
- .2 BC Building Code.
- .3 Roofing Contractors Association of BC (RCABC) Roofing Practices Manual.
- .4 RoofStar Guarantee Standards and Accepted Materials listed in the RPM.
- .5 Roofing Contractors Association of BC (RCABC).
- .6 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .7 ASTM D6162/D6162M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
- .8 ASTM D6163/D6163M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
- .9 ASTM D6164/D6164M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .10 CAN/CGSB 51.33-M, Vapour Barrier Sheet, excluding Polyethylene, for Use in Building Construction.
- .11 CSA B111-74, Wire Nails, Spikes and Staples.
- .12 CAN/ULC-S770-09, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
- .13 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .14 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

- .15 ASTM D5957-98(2013), Standard Guide for Flood Testing Horizontal Waterproofing Installations.
- .16 ASTM D41/D41M - 11(2016) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
- .17 ASTM E108-16, Standard Test Methods for Fire Tests of Roof Coverings

1.3 SUBMITTALS

- .1 Submit Shop Drawings of layout and heights for sloped/tapered insulation indicating roof perimeters, door and window sills, penetrations, curbs, slopes, ridges, valleys, low points in existing roof deck that may form areas of ponding, crickets, sumps and roof drain locations. Identify conflicts between insulation heights and existing installed features. Contractor to confirm the existence and locations of existing tapered joists and sloped insulation.
- .2 Submit insurance confirming hot work and torching coverage.
- .3 Submit Product data on material characteristics, performance criteria, and limitations for each product to be used.
- .4 Submit certificate that the installer is certified by the membrane manufacturer for the methods specified.
- .5 Submit written inspection report, if requested by the Departmental Representative, from the membrane manufacturer stating that the materials used on site meet the criteria specified and are compatible with each other. Submit report to the Departmental Representative within 48 hours of visit.
- .6 CAN/CSA-A123.21 Test Report: Submit the test report showing that the full roof assembly (sheathing, air/vapour barrier membrane, insulation, overlay board and roof membranes) has been tested to CAN/CSA-A123.21. The dynamic wind uplift resistance as per CSA A123.21 must exceed the below specified wind loads. Refer to Figure 1.3.2.1 for roof zone descriptions.
 - Corner (C): -3.3 kPa
 - Edge (S): -1.5 kPa
 - Field (r): -1.1 kPa
 - End zone width (z): 6.6 ft (2 m)

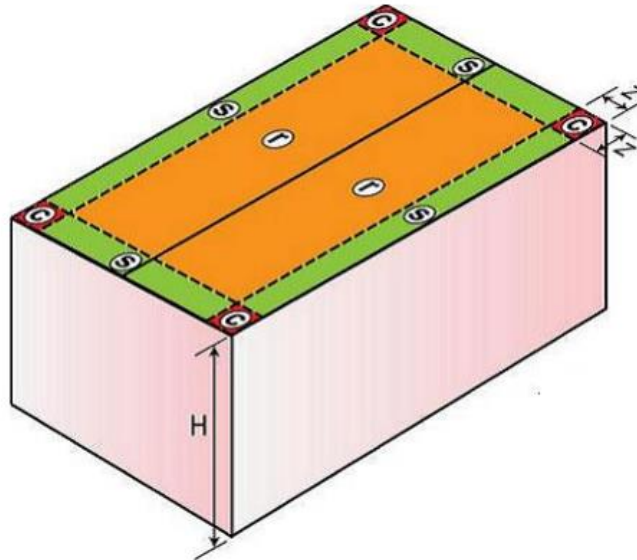


Figure 1.3.2.1 Roofing zones (courtesy: Wind-RCI by NRCC)

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1.4 QUALITY ASSURANCE

- .1 Conform to latest Guarantee Standards of Roofing Contractors Association of British Columbia (RCABC) as published in the RCABC Roofing Practices Manual, unless modified by contract documents to exceed those minimums.
- .2 Contractor must be a member in good standing with the Roofing Contractors Association of British Columbia (RCABC).
- .3 Foreman shall have a minimum of 10 years' experience in the roofing industry.
- .4 Use only Redseal trades people for roofing installation.
- .5 Do work in accordance with applicable standard in RCABC Roofing Manual except where specified otherwise.

1.5 MOCK-UP

- .1 Construct a minimum 10 m² mock-up of roof system in location acceptable to Departmental Representative showing typical lap joint, corner, penetration, and drain prior to installation of roofing system.

- .2 Arrange for Departmental Representative's review during construction of the mock-up a minimum of 48 hours in advance.
- .3 Mock-up may remain as part of Work if accepted by Departmental Representative.
- .4 Do not commence roof installation until the Departmental Representative has reviewed the mock-up.
- .5 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the Work of this Section.

1.6 NOTIFICATION AND TESTING

- .1 Notify the Departmental Representative at least 48 hours before commencement of any roofing work.
- .2 Notify the Departmental Representative and the Contractor's Testing Agency each morning that work is occurring.
- .3 The Departmental Representative reserves the right to have cut tests made to establish quality of work. Such tests shall be made in the presence of the Contractor. Cost of tests and subsequent repairs shall be borne by the Contractor.
- .4 The review and testing service does not relieve the Contractor of their responsibility for quality control of production and for errors made by them.

1.7 ENVIRONMENTAL AND SAFETY CONDITIONS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.
- .2 Roofing application shall not be carried out when materials are damp, or when ambient temperatures are less than manufacturer's specifications.
- .3 Be responsible for the safe disposal of all debris from the job site and in compliance with the Environmental Protection Act.
- .4 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of products including special conditions governing use.

- .5 Provide a minimum one hour fire watch including infrared thermography when torches are used; it shall include checking the roof's underside for smouldering (whenever possible), as well as the top side. Walk the day's entire production area to check for smoke and hot spots.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in their original packaging bearing the manufacturer's name, the grade, weight and applicable standards.
- .2 Ensure shelf life of all materials has not elapsed.
- .3 Store material in accordance with manufacturer's directions.
- .4 Remove from site any material damaged or exposed to wet weather.
- .5 Do not overload the structure or adjacent structures, including suspended slabs.
- .6 Store rolls on ends with selvage edge up, one (1) pallet high only.
- .7 Ensure all rolled base sheet membranes are maintained at a temperature between 10°C and 40°C prior to use.
- .8 Store solvent based liquids, adhesives, and primers away from excessive heat and open flames and at temperatures between 15°C and 26°C.

1.9 WARRANTY

- .1 Refer to 01 78 36 – Warranties and Bonds.

1.10 STANDARDS

- .1 In the event that the drawings and specifications differ from the manufacturer's printed instruction, to such a degree that the specified warranties may be affected, notify the Consultant for their written instructions.

Part 2 Products

2.1 PRIMERS

- .1 Asphalt primer: to CGSB 37-GP-9Ma, VOC content as recommended by manufacturer.

- .2 Primer for Reinforced Liquid Flashing Membrane: Translucent cloudy two-component polymethyl methacrylate-based (PMMA) primer. Acceptable products:
 - .1 ALSAN RS 276 by Soprema
 - .2 Pro Primer W by Siplast
 - .3 Or approved alternative.

2.2 VAPOUR RETARDER

- .2 Single-ply adhered bituminous membrane consisting of:
 - .1 Type 2, Class C, Grade 2 SBS modified bituminous membrane material, reinforced with a minimum 180 gram/m² glass fibre or nonwoven polyester mat with minimum individual membrane thickness of 2.5 mm to CGSB 37-GP-56M. Top surface – polyethylene, Bottom surface – polyethylene. Fully adhered with compatible adhesive and torched seams.
 - .2 Acceptable Products:
 - .1 Sopralene Flamstick 180 by Soprema
 - .2 Paradiene 20 SA by Siplast.
 - .3 Or approved alternative.

2.3 BASE INSULATION

- .1 Refer to Section 07 21 13 – Board Insulation

2.4 INSULATION OVERLAY BOARD

- .1 High Density Polyisocyanurate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant closed-cell polyisocyanurate substrate, minimum 12 mm thick, Acceptable Product:
 - .1 IKOTherm CoverShield by IKO
 - .2 Invinsa FR by Johns Manville
 - .3 Or approved alternative.

2.5 MODIFIED BITUMEN MEMBRANE

- .1 Two ply system made from prefabricated modified bitumen membranes containing minimum 11% of elastomer Styrene Butadiene Styrene (SBS) and reinforced with non-flammable, fireproof and stress-resistant insert of glass fibre and polyester composite.

- .1 Cap Sheet and Cap Sheet Flashing/Stripping:

- .1 Properties:

- .1 Application: Torch Application:
- .2 Type II in accordance with ASTM D6162. Class A in accordance with ASTM E108, Grade G in accordance with ASTM D6164 material
- .3 Reinforcing: Reinforced with composite polyester/glass fibre mat
- .4 Thickness: Minimum individual membrane thickness of 3.5 mm to CGSB 37-GP-56M.
- .5 Bottom Surface: thermofusible plastic
- .6 Top Surface: Granulated.
- .7 Colour: Selected by the Departmental Representative.

- .2 Acceptable Products:

- .1 Paradiene 30 TG by Siplast Inc.
- .2 Soprelene Flam 180 GR by Soprema Inc.
- .3 Or approved alternative.

- .2 Base Sheet and Base Sheet Flashing/Stripping Self-adhered: Type 2, Class C, Grade 2 material, reinforced with a minimum 180gram/m² glass fibre mat with minimum individual membrane thickness of 2.5 mm to CGSB 37-GP-56M.

- .1 Paradiene 20 EG SA by Siplast Inc.
- .2 Sopralene Flam Stick by Soprema Inc.
- .3 Or approved alternative.

2.7 REINFORCED LIQUID FLASHING MEMBRANE

- .1 Description: Two-component polymethyl methacrylate-based (PMMA) liquid membrane combined with fleece fabric to form a reinforced membrane for flashings and parapets. Acceptable products:
 - .1 Alsan RS 230 Flash, by Soprema
 - .2 Parapro 123 Flashing System by Siplast
 - .3 Or approved alternative.

2.8 FABRIC REINFORCEMENT FOR LIQUID FLASHING MEMBRANE

- .1 Description: Non-woven, needle-punched polyester fabric used as fabric reinforcement in liquid-applied membrane systems. Acceptable products:
 - .1 Alsan RS Fleece by Soprema
 - .2 Pro Fleece by Siplast
 - .3 Or approved alternative.

2.9 DRAINS

- .1 Cast iron with clamping ring, basket, gravel stop, and dome. Acceptable Products:
 - .1 Watts Canada RD100 Large Area Roof Drain
 - .2 Or approved alternative.

2.10 SCUPPER

- .1 4" Copper Box Clamp Scupper Complete with membrane clamping collar and 4" flange by:
 - .1 Menzies Metal.
 - .2 Thaler Metal.
 - .3 Or approved alternative.

2.11 ACCESSORIES

- .1 Insulation Fasteners: Conform to FM Global standard and membrane manufacturer's written recommendations for wind uplift and corrosion resistance, length required by insulation thickness plus 25 mm max.

- .2 Roofing Nails: to CSA B111-1974, Table 12, of galvanized steel or aluminum, sufficient length to penetrate wood substrate at least 25 mm.
- .3 Vent Stack Flashings: spun aluminum sleeve to fit over the vent stack with sufficient space to insulate. A spun aluminum cap to fit outside the sleeve and inside the vent stack. The cap is not to restrict the vent stack inside diameter.
- .4 Metal Securing Strips: 25 mm wide, 0.67 mm galvanized steel, or 1.5 mm aluminum, double hemmed, fastened at 200 mm (8") o.c., installed at all vertical or overhead terminations.
- .5 Adhesives: as recommended by manufacturer of materials being adhered, for applicable ambient conditions.
- .6 Pourable Sealer: solvent asphalt based mastic and sealing compound.
 - .1 Two part polyurethane by Soprema.
 - .2 IC Sealant, one part elastomeric polyurethane sealant by Soprema
 - .3 Or approved alternative.
- .7 Prefabricated Pitch Pans:
 - .1 Interclip prefabricated polyurethane pitch pocket system with IC Duomastic polyurethane two-part adhesive by Soprema.
 - .2 Metal pans, minimum 24 ga., to ASTM A526-75 with Z-275 zinc coating, in size to suit application.
- .8 Gas Pipe Support: steel base plate welded to a steel pipe, a solid steel core, threaded to provide 51 mm maximum vertical adjustment, stainless steel strap anchor (3 mm x 25 mm), two (2) rollers, and 1.6 mm aluminum sleeve with sufficient space to insulate.
 - .1 Pipe Support by Thaler Roofing Specialities Products Inc.
 - .2 Or approved alternative.
- .9 Wire & Cable Flashing: prefabricated, insulated, seamless metal base flange with stainless steel pipe extending out.
- .10 Flash-Tite Electrical Conduit "Gooseneck" by Lexcor (Lexsuco).

- .11 Flash-Tite Model CF-WO by Lexcor (Lexsuco).
- .12 Electrical Roof Flashing 3” diameter by Menzies Metal Products.
- .13 Roof Vents: continuous welded with 100 mm (4”) flanges. Welded areas shall be cold galvanized and all interior and exterior surfaces painted. Acceptable Products: 8” metal Roof Stem Vent or Spun Aluminum Breather Vent by Menzies Metal Products
- .14 Material Fasteners
 - .1 Corrosion resistant screws and hexagonal steel plates. Stainless steel, DT2000 coating by Leland, or similar. HDPE, PVC, or Galvalume insulation plates.

Part 3 Execution

3.1 PRE-INSTALLATION MEETING

- .1 Convene one week before commencing work of this Section.

3.2 PROTECTION

- .1 Dispose of rain water away from face of building until drains or hoppers are installed and connected.
- .2 Protect new and existing roofing from traffic and damage.
- .3 At end of each day’s work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.
- .4 Seal and protect exposed edges.

3.3 PRECAUTIONS

- .1 Do not carry out roofing application when materials are damp, or when ambient temperatures are less than -15°C . Postpone roofing work when inclement weather appears imminent. Minimum temperature for solvent-based adhesive is -5°C .
- .2 Apply each part of roofing system only when surfaces are clean and dry.
- .3 Locate equipment and materials in areas designated by the Departmental Representative.

- .4 Conduct operations so as to leave deck exposed for minimum period of time. Protect, as required, to prevent water infiltration or environmental damage to building interior.
- .5 All aspects of the roofing operation shall follow in close sequence. No part of the operation shall be far ahead of the succeeding part that the latter cannot be finished that working day.
- .6 Erect and maintain safety fences around tall equipment and material.
- .7 Take precautions to minimize introduction to asphalt fumes to interior space. Coordinate with Departmental Representative to close air intakes where practical.
- .8 The Contractor is responsible for the disconnection, relocation and re-installation of all existing mechanical and electrical services and equipment.

Ensure that the Departmental Representative is aware of any such work that may impact the interior environment of the building, prior to disconnection or shut down.
- .9 Disconnection and reconnection of all electrical services to meet latest regulations of Canadian Electrical Code and applicable Municipal and Provincial Codes and Regulations. In each and every instance of application, Code, Regulation, Statute, By-Law or Specification, the most stringent requirements shall apply.
- .10 Provide the Departmental Representative with a schedule indicating time and dates, for any work creating a disruption to the interior environment and obtain the Departmental Representative's written approval.
- .11 All adjacent parts of the building shall be protected from damage caused by roofing operations. Cover walls and other surfaces in the vicinity of hoisting apparatus with heavy canvas or other suitable protective material. Any damage caused under this contract shall be repaired to match the original materials and appearance.
- .12 Fire Extinguishers: Maintain at least one (1) fully-charged fire extinguisher with shutoff nozzle, ULC labelled for A, B and C class per torch applicator, within 6 m of torch applicator. Strictly adhere to all safety guidelines for the torching of modified bituminous membrane.
- .13 Any sharp projections, that in the opinion of the Departmental Representative may penetrate the membrane, shall be grounded smooth and flush.
- .14 All aspects of the roofing operation shall follow in close sequence. No part of the operation shall be far ahead of the succeeding part that the latter cannot be finished that working day.

3.4 SUBSTRATE PREPARATION

- .1 The roof deck and existing roof construction shall be structurally sound to provide support for the new roof system. Notify the Departmental Representative of any rusted or deteriorated decking, to determine method of treatment or replacement.
- .2 Remove all existing membrane, flashings, cants and wood blocking and sweep clean. Remove only amount of roofing and flashing that can be made watertight with new materials during the work day or before the onset of inclement weather.
- .3 The substrate surface shall be firm, free from dust, loose material, excess moisture and oil-based curing agents.
- .4 Prepare substrate surface in accordance with the membrane manufacturer's written instructions or this specification whichever is more stringent.

3.5 PRIMER APPLICATION

- .1 Apply by brush or spray at a rate as designated by manufacturer.

3.6 VAPOUR RETARDER INSTALLATION

- .1 For self-adhering vapour retarder.
 - .1 Prime deck as recommended by manufacturer.
 - .2 Install under new wood blocking as detailed on Drawings.
 - .3 Install membrane with minimum 75 mm (3") side laps and 150 mm (6") end laps.
 - .4 Apply pressure to membrane surface to ensure adequate adhesion. Avoid fish mouths, buckles, or any other application defect. Stagger end laps by a minimum of 12" (300 mm).
 - .5 Roll membrane per manufacturer's requirements.
 - .6 Overhang vapour retarder at all edges and extend up verticals 400 mm (16") minimum. Wrap over ends of insulation boards at roof perimeter and penetrations.
 - .7 Ensure that vapour retarder at roof edges and vertical building surfaces maintains, together with wall vapour retarder, integrity of vapour retarder system for the building.

3.7 SURVEY

- .1 Survey roof deck during installation to locate low points not associated with drains and notify the Departmental Representative of the findings.

3.8 INSULATION INSTALLATION

- .1 For mechanically fastened insulation attachment:
 - .1 Install insulation to meet thickness and R-Value as indicated on Drawings.
 - .2 In sump area around drain reduce base insulation by 25 mm. Chamfer transition between insulation boards as detailed.
 - .3 Stagger all joints in the boards. Mechanically fasten insulation to RCABC uplift values.
 - .4 Install one layer of tapered insulation in areas indicated on Drawings, mechanically fasten to RCABC uplift values. Ensure modules are placed in parallel rows, in a pre-designed order and as indicated on the shop drawings.
 - .5 All systems shall have additional fasteners and adhesive at slope transitions such as valleys, sumps, and slope to flat, etc., to prevent movement of membrane, overlay board and insulation. Re-fasten if movement of more than 5 mm under reviewers foot.
- .2 Tapered Insulation
 - .1 At wood decks: Fasteners to be installed at 300 mm (12") o.c. along length of transition.
 - .2 Limit areas of ponding to a maximum of two square metres, maximum 6 mm deep or as required by the warranty.
 - .3 Final insulation installation shall provide complete support to the roof membrane. No tenting or unsupported protection board or roof membrane is permitted. Provide slope to zero tapers, refasten insulation, or remove and reinstall insulation to provide complete and even support to the membrane system.
 - .4 Supply factory tapers at all transitions. Leave no steps in insulation due to stepped ends of tapered insulation.

- .5 Insulation slopes and thicknesses shall be as indicated on Drawings and shall be a distinct separate layer with joints staggered over the base insulation.
- .6 Insulation fillers shall meet requirements of base insulation.
- .7 Do not site cut slopes or valley corners.

3.9 INSULATION OVERLAY BOARD INSTALLATION

- .1 Install overlay over insulation as detailed on Drawings.
- .2 Install overlay board with long sides at right angles to underlying insulation.
- .3 Stagger all joints in the boards. Mechanically fasten or adhere to FM Global Standard.

3.10 BASE SHEET INSTALLATION

- .1 For self-adhered base sheet:
 - .1 Ensure base sheet membrane is installed parallel to the long side of the underlying insulation overlay board.
 - .2 Commencing at the lowest point of the roof and perpendicular to the roof slope, adhere the base sheet to a primed substrate. Apply base sheet with 75 mm (3") side laps and 150 mm (6") end laps. Extend the base sheet up vertical, to a point as detailed on Drawings and fasten at 225 mm (9") O.C..
 - .3 Ensure base sheet is unrolled to enable membrane to relax prior to installation, for the amount of time required by weather conditions.
 - .4 Torch weld all lap joints by heat softening the membrane and pressing the edge of the membrane firmly with a roofing trowel.

3.11 CAP SHEET INSTALLATION

- .1 For torch applied cap sheet:
 - .1 Plan membrane application so that laps are not superimposed over laps of the base sheet. Mark a chalk line where the first course is to start. Unroll 2.0 m to 3.0 m of the membrane and line it up to the chalk line or to selvage edge. Reroll and commence application. If the roll goes out of line by more than 12 mm, cut and realign.

- .2 With a torch, adhere one-ply of the membrane, granule side up. Carefully heat underside of membrane and slowly unroll. Constantly check adhesion to ensure proper bonding is achieved.
- .3 Side laps shall cover the selvage edge and be a minimum of 75 mm. End laps must be 150 mm.
- .4 Using a torch and round nosed roofing trowel, embed surface granules into heated and soft bitumen, from the chalk line to the edge of the cap sheet at the top of the horizontal surface (a minimum distance of 200 mm from the edge of the cap sheet).

3.12 MEMBRANE FLASHINGS AND SHEET STRIPPING INSTALLATION

- .1 Install flashing membrane stripping in accordance with specific system requirements using longest pieces practical. Terminate flashing as indicated on Drawings in accordance with manufacturer's instructions.
- .2 Plan for flashing membrane installation such that laps are not superimposed over the laps of the underlying membrane.
- .3 Extend flashing/stripping vertically a minimum of 200 mm beyond the horizontal field surface.
- .4 Overlay base sheet flashing over horizontal field base sheet membrane a minimum of 100 mm.
- .5 Overlay cap sheet flashing over horizontal field cap sheet membrane a minimum of 150 mm.
- .6 Overlap flashing membrane side laps a minimum of 75 mm.
- .7 Install reinforcing gussets at all inside and outside corners in accordance with the manufacturer's recommendations.
- .8 Base sheet flashing/stripping shall be fully adhered over roof membrane and vertical surface in accordance with manufacturer's instructions. Cap sheet flashing shall be torched over base sheet membrane with specified overlap in accordance with manufacturer's instructions.
- .9 Nail flashing/stripping to the interior face of the parapet, mechanical curb, wall at a location and spacing as indicated on Drawings.

- .10 Secure all membrane flashing/stripping to verticals with continuous securement strips installed along the top edge of membrane flashings and fastened at 200 mm (8") o.c. Lap all strips to the selvage a minimum of 75 mm and seal the laps.
- .11 Granules shall be embedded for the preparation of the salvage edges where membrane will overlap the mineral surface.
- .12 Using a chalk line, lay out a straight line on the cap sheet surface. Set line parallel to the roof edge and 200 mm (8") from the base of the upstand.
- .13 Using the propane torch, heat the back of the flashing strip until the coating flows and bonds to the roof and up to the vertical. Press in firmly for proper adhesion. Continue by bonding the upper portion of the wall, taking precautions not to stretch the membrane.
- .14 At all head laps, where "T" joints occur, cut corner of membrane to be overlapped, on a 45 degree angle. Apply manufacturer approved mastic seal to cover granule portion at overlap areas and to fill the step where the membrane "T" overlaps.

3.13 PRIMER FOR REINFORCED LIQUID APPLIED FLASHING MEMBRANE INSTALLATION

- .1 Mask off application area with masking tape.
- .2 All wood and concrete surfaces to be primed.
- .3 Comply with manufacturer's written application instructions for surface preparation and priming requirements.
- .4 Thoroughly mix primer resin and catalyst components to manufacturer's written instructions. Add catalyst only to the amount of material that can be used within 10 to 15 minutes.
- .5 Apply the resin to the substrate using rollers, brushes or notched squeegees for this purpose.
- .6 Spread the primer evenly so that the substrate is completely saturated with a single application.

3.14 REINFORCED LIQUID APPLIED MEMBRANE FLASHING INSTALLATION

- .1 Thoroughly mix resin and catalyst components to manufacturer's written instructions.
- .2 Add catalyst only to the amount of material that can be used within 10 to 15 minutes.

- .3 Apply the first layer of resin to the substrate using rollers, brushes or notched squeegees for this purpose in accordance with the manufacturers written coverage rate.
- .3 Lay out and fully saturate the polyester reinforcement on the resin, prevent the formation of wrinkles, swellings or fish mouths and remove wrinkles and air bubbles under the reinforcement.
- .4 Apply the second resin layer on top of the reinforcement in accordance with the manufacturers written coverage rate.
- .5 The final resin coating shall be smooth and even.
- .6 Overlap each reinforcement sheet over previous sheets a minimum of 50 mm (2 in).
- .7 Extend flashing 200 mm (8") onto the horizontal field surface or as required by the membrane manufacturers written application instructions.
- .8 Extend flashing vertically a minimum of 200 mm (8") beyond the horizontal field surface.
- .9 Extend the liquid membrane a minimum of 6 mm (1/4") past the edge of the reinforcing fabric at end laps.
- .10 Remove masking tape before membrane cures.

3.15 VENT FLASHINGS INSTALLATION

- .1 Install vent stack covers at all existing vent pipes. Extend existing vent pipes as required to a minimum height of 400 mm (16") above the completed membrane surface. Provide sufficient allowance for pipe expansion or contraction.
- .2 Prime vent stack flange, centre over existing vent stack and set into heated base sheet membrane. Flash with one-ply of base sheet membrane for reinforcement, to extend a minimum of 200 mm beyond flange. Complete installation with the application of the cap sheet membrane.
- .3 Install batt insulation between vent stack and aluminum stack flashing.
- .4 Caulk as detailed on Drawings.
- .5 Secure vent caps with self-tapping screws.

3.16 METAL FLASHINGS

- .1 Refer to Section 07 62 00.

3.17 WALKWAYS INSTALLATION

- .1 Roof Pavers: Reuse existing pavers.

3.18 GENERAL

- .1 Patch cap sheet membrane utilizing patches with a minimum size of 450 mm (16") by 1000 mm (3 ft.).
- .2 Minimum length of cap sheet on flat run of roof shall not be less than 1000 mm (3 ft.).
- .3 Discard any cap sheet rolls with or deformed ends.
- .4 Following completion of new roofing, torch soften and apply a liberal application of manufacturer approved bulk type mineral granules to cap sheet membrane edges where asphalt has extruded or flowed beyond clean lines and to all surface damage.
- .5 Remove splices in delivered rolls. Cut back the roll 450 mm (16") on both sides of the splices.

3.19 COMPLETION OF DAY'S WORK

- .1 Install water cut-offs at the end of each day's work; Construct water cut-off as a permanent insulation cell wall. Note location of each insulation cell on (as built) record drawings. Where a day's work is more than 200 m², construct additional cell walls in order to keep insulation cells to 200 m² maximum.
- .2 Construct cell dividers using base sheet or vapour barrier.
- .3 Do not incorporate temporary roofing membranes into main roof system. Remove all membranes utilized for this purpose and discard.
- .4 Inspect all laps of the membrane application to ensure they are properly bonded. Repair any deficiencies before leaving the site for the day.
- .5 Leave no openings for water ingress into the roof assembly.
- .6 Leave no base sheet exposed overnight unless all seams are sealed before leaving the site.

- .7 Remove progressively from the site all debris created by the execution of Work and dispose of same at certified disposal location. Contractor may be asked to produce proof of disposal location.

3.20 FIELD QUALITY CONTROL

- .1 Review and testing of membrane roofing and associated work will be done by a agency appointed and paid for by the Contractor. Notify the Testing Agency at least 48 hours before commencement of any roofing work.
- .2 All Testing Agency reports to be submitted to the Departmental Representative in addition to the Contractor.
- .3 The Departmental Representative may have cut tests made to establish quality of work. Such tests will be made in the presence of the Contractor. Cost of tests and subsequent repairs shall be borne by the Contractor.
- .4 Notify the Departmental Representative in the event that specifications conflict with the manufacturer's recommendations.
- .5 The review and testing service does not relieve the Contractor of its responsibility for quality control.
- .6 All waterproofing plies to be checked for penetrations after installation by Detec or SMT Membrane Integrity Scan.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Furnish all labour, materials, equipment and services necessary for the design, supply, fabrication and erection of the complete sheet steel metal roofing system as indicated on the drawings and as specified.

1.2 REFERENCE STANDARDS

- .1 CSSBI CSSBI 20M-08, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.
- .2 ASME B18.6.4-1998 (R2005), Thread Forming And Thread Cutting Tapping Screws And Metallic Drive Screws - Inches
- .3 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples. (Withdrawn)
- .4 RCABC Roofing Practices Manual and Roofstar Guarantee Program.
- .5 SMACNA Architectural Sheet Metal Manual.
- .6 ASTM A167-99, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip. (Withdrawn)
- .7 ASTM A653/A653M-15, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .8 ASTM A792/A792M-10(2015), Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
- .9 CAN/CGSB 93.1, Sheet Aluminum Alloy, Prefinished, Residential. (Withdrawn)
- .10 CAN/CGSB 93.3, Prefinished Galvanized and Aluminum-Zinc Alloy Sheet for Residential Use. (Withdrawn)
- .11 CAN/ULC-S702 Standard for Thermal Insulation Mineral Fibre for Buildings
- .12 BC Building Code

1.3 DESIGN RESPONSIBILITY

- .1 The design, fabrication, erection and fastening of the metal roofing system shall be the complete responsibility of the Contractor.
- .2 The Drawings indicate the general arrangement of the work, the dimensions, and major architectural and structural elements of construction. The Drawings and Specifications do not necessarily indicate or describe all items required for the full performance and completion of the work of this Section.
- .3 The work of this Section shall include, but shall not be limited to, the design, fabrication, supply and erection of the following:
 - .1 Sheet steel metal roofing system.
 - .2 All necessary connection hardware and supporting members for attachment of the metal roofing to the exterior backup roof, including brackets, clips, channels and the like.

- .3 All metal siding panel caps, closure strips and duct vent hood assemblies required in connection with the above installations.
- .4 Design requirements include but are not necessarily limited to the design and sizing of all metal roofing, connection hardware including supporting track members, all anchors, fasteners, clips and girts as required for the proper anchorage of the roofing to the building structure, even though not indicated on the Drawings or Specifications. Connection hardware shall be of material and design that is compatible with the metal roofing system.
- .5 The metal roofing details shown on the Drawings are included for the purpose of indicating the preferred profiles and dimensions necessary to achieve the design intent and are not intended to eliminate other design proposals. Minimal dimension adjustments to those shown on the Drawings may be made in the proposed design in the interest of fabrication or erection methods or techniques, or weatherability, provided that the design intent and the intent of the Specifications are maintained.
- .6 The connection details and attachment hardware shown are diagrammatic only and are included for the purpose of indicating the preferred dimensions and are not intended to eliminate other connection details or hardware attachment proposals.
- .7 The Departmental Representative's reviews of anything related to the work of this Section is subject to the understanding that the Contractor is fully responsible for the design and performance of all work of this Section.

1.4 DESIGN CRITERIA

- .1 The following criteria shall apply to the design of the preformed metal roofing system.
 - .1 Design roofing, connection and attachment hardware, suspension systems and fasteners to accommodate expansion and contraction.
 - .2 Connection and attachment hardware shall not cause staining to siding or to other adjoining materials.
 - .3 Labels and trademarks, including applied labels, shall not be visible on the finished work.
 - .4 There shall be no oil canning, warping or buckling of roofing faces, including when roofing panels are under full design loads.
 - .5 Roofing system shall provide or make allowances for free and noiseless vertical and horizontal thermal movement, due to the contraction and expansion of component parts of the cladding system. Buckling, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to the thermal movement of any or all component parts will not be accepted.
 - .6 Limit the deflection of the components of the roofing system as required to prevent any adverse effects on the watertight integrity of the system assembly or on any related component.

- .7 Design roofing system for dead loads, snow loads, ice loads and wind loads, and combinations thereof, in accordance with the Building Code in effect at the Place of the Work.
- .8 Design roofing system to allow for condensation occurring within the system and water to drain to the exterior of the building envelope and for moisture to be prevented from entering the building. Drainage slots must be sufficiently large to overcome adhesion force (surface tension) of water, minimum of 8mm in height and 10mm in length.
- .9 Design system for all fasteners to be concealed.

1.5 SUBMITTALS

- .1 Shop Drawings: Submit Shop Drawings for the metal roof system in accordance with Section 01 33 00 and as follows:
 - .1 Incorporate plans, elevations and levels, sections and half-size details for all work of this Section. Include panel sizes, bow, camber and squareness tolerances.
 - .2 Show and specify all metal thicknesses, types and finishes; direction and magnitude of thermal expansion; type of construction including joinery, fasteners, and drag load fasteners; all anchorage assemblies, connections and components; and the fabrication and erection tolerances.
 - .3 Fully detailed roof assembly including deck underlay, modified bituminous sheet air/vapour barrier, board Insulation, and metal components.
 - .4 Indicate methods to achieve watertight assembly, including sealants, penetration seals, drainage path of moisture from within assembly to exterior of envelope.
 - .5 Indicate all materials and details for the proposed use, design and application procedures for all anchorage.
 - .6 Do not fabricate any work until the Departmental Representative has reviewed the Shop Drawings and samples.
 - .7 Shop drawings shall be sealed by a Professional Engineer licensed to practice structural engineering in the place of the work. Indicate design loads on submitted shop drawings.
 - .8 The Registered Professional Engineer who signed and sealed the shop drawings shall perform sufficient field reviews in order to allow them to provide a letter of professional assurance after completion of the Work, giving assurance that the Work has been fabricated and installed in general conformance with the sealed shop drawings. Written inspection reports of field reviews shall be submitted within 48 hours of the field reviews.

- .2 Manufacturer's Field Review Reports: The manufacturer shall provide periodic field review of the installation and shall provide written confirmation that the system is installed in conformance with their instructions and the project documents. Submit written inspection reports of field review within 48 hours of each site visit. Minimum of two site visits to be completed.
- .3 Letters of Assurance: Submit with the initial Shop Drawing submission an "Assurance of Structural Design" and commitment for "Field Review" on BCBC Standard Form by the engineer who sealed the Shop Drawings. On completion of the installation, submit an "Assurance of Field Review and Compliance" on BCBC Standard Form by the same engineer.
- .4 Samples:
 - .1 Submit duplicate colour samples of manufacturer's standard range of metal panel finishes to the Departmental Representative for colour selection.
 - .2 Sample Panels: Submit sample of sheet steel metal roof panel assembly to the Departmental Representative for review. Panel shall be approximately 1200 mm x 1200 mm square showing typical connection hardware, fastening method and finish to be provided. Submitted panels to bear the selected finish.
- .5 Product Data: Submit catalogue details for metal roofing system, illustrating profiles, dimensions and methods of assembly, installation, procedures, and recommendations. Include data indicating that Products have been tested and comply with specified performance requirements.
- .6 Maintenance Data: Submit cleaning and maintenance data (2 hard copies or 1 electronic copy) and warranty certificates for incorporation into maintenance manual specified in Section 01 78 23 – Maintenance and Renewal Manual

1.6 QUALITY ASSURANCE

- .1 Metal roofing manufacturer shall have complete in-house production facilities and a minimum of ten years experience in manufacturing metal roofing systems in the immediate past.
- .2 Installer shall be approved by metal roofing manufacturer and have a minimum of five years experience in installation of metal roofing systems in the immediate past. and shall have been responsible for satisfactory installations similar to the work of this Contract..
- .3 Perform shop tests to ensure dimensional and finish qualities are to specified standards.
- .4 All metal roofing practices and details shall be in accordance with RCABC details for RGC Metal Roofing Guarantee.
- .5 Obtain Products from single manufacturer.

1.7 MOCK-UP

- .1 Assemble a full-size mock-up of sheet metal roofing system on site for review by the Departmental Representative.
- .2 Mock-up shall include all components of the system, including all roof components including typical joints and connection hardware, and typical tie-ins to adjoining systems, all finished as specified.
- .3 Locate where directed by the Departmental Representative.
- .4 Allow for Departmental Representative's review of mock-up before proceeding with the work of this Section.
- .5 Mock-up may remain as part of the Work.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Do not expose stored Products to wetting or damage. Store neatly, properly stacked.
- .2 Protect prefinished material during fabrication transportation, unpacking, moving, storage, handling and placement of roofing panels or their component parts so as to prevent damage., transportation, site storage and erection,.
- .3 Remove all units or components that are stained, watermarked, cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Protect finish and edges in accordance with metal roofing manufacturer's directions.
- .5 Store material in accordance with metal roofing manufacturer's directions.

1.9 WARRANTY

- .1 Remedy all defects which appear within a period of five years from the date of Substantial Performance of the Work.
- .2 Make all necessary repairs and replacements within 48 hours of receipt of written notification.
- .3 Obtain from the membrane manufacturer a material warranty stating that the membrane and membrane flashings shall be free of manufacturing defects and premature deterioration and will not leak for a five (5) year warranty period.
- .4 Provide a manufacturer's written warranty: Furnish panel manufacturer's written warranty covering failure of factory-applied exterior finish within the warranty period. Warranty period for finish: 40 years after the date of Substantial Completion.

1.10 RCABC GUARANTEE

- .1 Quality Assurance
 - .1 Workmanship Standards:
 - .1 Conform to latest Guarantee Standards of Roofing Contractors Association of British Columbia (RCABC) as published in the RCABC Roofing Practices Manual for a five (5) year Guarantee, unless modified by contract documents to exceed those minimums.
 - .2 Independent Inspection:
 - .1 Perform using an independent inspection company acceptable to RCABC and the Departmental Representative.
 - .2 Perform as required by RCABC under the five (5) year Guarantee Program.
 - .3 Inspection costs are to be paid directly by Departmental Representative.
 - .2 Guarantee:
 - .1 Provide the standard Roofing Contractors Association of British Columbia (RCABC) five (5) year Guarantee.

Part 2 Products

2.1 SHEET STEEL PANEL

- .1 Steel roof panel: G90 galvanized steel sheet to ASTM A653/A653M, commercial quality with Z275 designation zinc coating. 24 gauge (0.6070mm) thickness. Acceptable Products:
 - .1 Marquis 3000 by Vic West Inc.
 - .2 Or approved alternative.
- .2 Profile: 300 roofing profile with interlocking batten ribs at 300 mm spacing.
- .3 Finish:
 - .1 Prefinished steel with factory applied silicone modified polyester on primer, both paint and primer back cured. Include paint system coating to reverse side of coil stock to prevent corrosion of backside surfaces and uniform colour.
 - .2 Performance Level: "CSSBI S8-2008. Coating thickness not less than 25 micrometres +/- 3 micrometres (1.0 mils +/- 0.1 mils).
 - .3 Product: Perspectra Plus Series

- .4 Colour: The Departmental Representative will select up to four colours from the manufacturer's standard colour range.
- .5 Roof Panel Attachment System: Hidden fastener, purpose-made, thermally responsive full height clip system, designed to allow for full thermal expansion and contraction of the exterior roof sheet. To be fabricated from a minimum of 1.22 mm (0.050") Z275 galvanized steel.
- .6 Fasteners: as recommended by panel manufacturer.

2.2 INSULATION

- .1 Refer to 07 52 16 – MBM Roofing and Waterproofing

2.3 AIR/VAPOUR RETARDER

- .1 Refer to 07 52 16 – MBM Roofing and Waterproofing
- .2 Refer to Section 07 65 16 – Self-Adhering Membrane.

2.4 ACCESSORIES

- .1 Subgirts and Below Roof Panel Supports: 1.2mm, 18 gauge to ASTM A653/A653M, Z275 galvanized steel in accordance with the manufacturer's requirements for panel attachment system.
- .2 Slip Sheet: Slip sheet membrane as recommended by manufacturer
- .3 Metal Flashing and Trim: Flashing, ridge pieces, knee/end caps, detachable battens and other profiles as applicable to be formed from same materials (thickness and finish) as the sheet steel roofing panels.
- .4 Cleats and Starter Strips: Metal and thickness to match roof panels, make cleats at least 50 mm wide and interlocked with metal flashings. Starter strips shall be continuous.
- .5 Sealants: As recommended by the metal roofing system manufacturer.
- .6 Washers: Same material as sheet metal, 1.0 mm thick with rubber packings.
- .7 Closures: Foam and metal closures to suit selected profile, to provide a complete watertight barrier.
- .8 Touch-Up Paint: As recommended by the prefinished material manufacturer.
- .9 Bituminous Paint: to CGSB 1-GP-108M, Type 2.
- .10 Gaskets: Soft, pliable, cold weather grade PVC foam, extruded profile for outer sheet.

2.5 FABRICATION – GENERAL

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC details, specifications and reviewed Shop Drawings.

- .2 Fabricate sheet steel roof panel and all accessories in longest practicable length to minimize field lapping.

2.6 FABRICATION – SHEET METAL FLASHINGS AND TRIM

- .1 Form prefinished metal panels to required profiles with bends sharp and true.
- .2 Ensure that metal panels are free of steel contamination from rollers.
- .3 Fabricate roofing panel systems to prevent entry of water into building and from collection within system assembly.
- .4 Join intersecting parts together to provide tight, accurately fitted joints with adjoining surfaces in true planes.
- .5 Fabricate formed and notched metal closures to close-off flutes at exterior. Seal also with neoprene foam filler.
- .6 Fabricate metal panels in one length; maximum 6,000 mm (20') for horizontal application; 12,000 mm (40') for vertical application; unless otherwise indicated on Drawings.
- .7 Prefinished metal panel terminations shall not have a raw metal edge or exposed fasteners. Panel ends shall be folded.
- .8 Fabricate flashings used in conjunction with the metal roof with S-locks for concealed fastening.
- .9 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

Part 3 Execution

3.1 EXAMINATION

- .1 Prior to start of erection, examine existing work and report to Consultant any unsatisfactory conditions.
- .2 Examine and obtain all necessary measurements of previously executed work which may affect the work to this Section.
- .3 Verify that backup construction is aligned for proper installation of sheet metal roofing system before commencing erection.

3.2 AIR/VAPOUR RETARDER

- .1 Refer to Section 07 65 16 – Self-Adhering Membrane.
- .2 Prime deck as recommended by membrane manufacturer.
- .3 Install under wood blocking as indicated on Shop Drawings.

- .4 Install membrane with minimum 75mm (3") side laps and 150mm (6") end laps. Support end laps with a strip of sheet metal between the deck and membrane as recommended by the manufacturer. At the end of the roll, affix a metal plate 6" x width of roll (15cm x width of roll) to support the air/vapour retarder end lap between the metal flutes.
- .5 Apply pressure to membrane surface to ensure adequate adhesion. Avoid fishmouths, buckles, or any other application defect. Stagger end laps by a minimum of 12" (300mm).
- .6 Overhang vapour retarder at all edges and extend up verticals 400mm (16") minimum. Wrap over ends of insulation boards at roof perimeter and penetrations.
- .7 Ensure that vapour retarder at roof edges and vertical building surfaces maintains, together with wall vapour retarder, integrity of air/vapour retarder system for the building.

3.3 INSULATION

- .1 Install insulation in accordance with the manufacturer's recommendations.
- .2 Install insulation only when building substrate materials are dry, free of frost, ice or condensation.
- .3 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .4 Fit insulation tight around clips, sub-girts and other protrusions.
- .5 Keep insulation minimum distance required from heat emitting devices such as recessed light fixtures, chimneys and vents.
- .6 Use boards of largest possible dimensions to reduce number of joints. Do not use boards with chipped or broken edges.
- .7 Offset both vertical and horizontal joints in multiple layer applications.
- .8 Do not cover insulation until reviewed by Consultant.
- .9 Ensure that the integrity of the air/vapour barrier system is maintained. Take extreme care that the systems are sealed where elements penetrate them, and that they extend across and are sealed at junctions between other parts of the barrier system.

3.4 INSTALLATION OF SHEET METAL ROOFING – GENERAL

- .1 Install sheet metal roofing in accordance with RCABC standard, all in accordance with Consultant reviewed Shop Drawings and the manufacturer's recommendations.
- .2 Protect metal surfaces in contact with concrete, mortar, plaster or other cementitious surface with isolation coating.

- .3 Install and seal metal cladding system to provide watertight protection to building enclosure.
- .4 Seal penetrations to the various moisture controlling components of metal cladding system.
- .5 Install various components within cladding assembly to provide positive controlled drainage of moisture to exterior of building envelope or drainage outlet.
- .6 Coordinate and install sheathing, air-vapour barrier (roof membrane) and insulation.
- .7 Use concealed fastenings except where otherwise approved by the Consultant before installation.
- .8 Provide sheet metal roof panel and all accessories in longest practicable length to minimize field lapping.
- .9 Attach components in manner not restricting thermal movement.
- .10 Install sheet metal roof panels using cleats spaced according to reviewed Shop Drawings.
- .11 Endlaps are permitted on metal roofing only and shall be located over supports. Minimum endlaps shall be 100 mm on roofs with a slope of 4 in 13 or more.
- .12 Seal endlaps with continuous sealant tape recommended by sheet metal roofing manufacturer.
- .13 Seal sidelaps with continuous lengths of taped sealant where required and connect at intervals not exceeding 600 mm as recommended by the manufacturer.
- .14 Flash roof penetrations with material matching roof panels and make watertight.
- .15 Form seams in direction of water-flow and make watertight.
- .16 Install notched and formed closures. Seal against weather penetration, where required.
- .17 When cutting or drilling prefinished material, exercise care to ensure that cuttings do not remain to rust on exposed prefinished surfaces. Where practicable, perform cutting and drilling so that cuttings do not strike or accumulate on exposed surfaces.
- .18 Finished surfaces shall be free from buckles, warps, waves, dents, oil canning, cutting deformities, or other defects.
- .19 Provide all cutting and flashing required for metal panel penetrations, including louvers, ducts, piping and the likings.

3.5 STANDING SEAM ROOFING INSTALLATION

- .1 Use 24 gauge (0.6070 mm) stainless steel 300 mm wide to make roofing with standing seams 300 mm on centre without straight run of standing seam exceeding 10 m.

- .2 Fold lower end of each pan under 20 mm.
 - .1 Slit fold 25 mm away from corner to form tab where pan turns up to make standing seam.
 - .2 Fold upper end of each pan over 50 mm.
 - .3 Hook 20 mm fold on lower end of upper pan into 50 mm fold on upper end of underlying pan.

- .3 Apply sheet metal roofing beginning at eaves. Loose lock pans to valley flashing and edge strips at eaves and gable rakes.

- .4 Finish standing seams 25 mm high on flat surfaces. Bend up one side edge 40 mm and other 45 mm.
 - .1 Make first fold 6 mm wide single and second fold 12 mm wide, providing locked portion of standing seam with 5 plies in thickness.
 - .2 Fold lower ends of seams at eaves over at 45 degrees angle.
 - .3 Terminate standing seams at ridge and hips by turning down in tapered fold.

- .5 Form valleys of sheets not exceeding 3 m in length. Lap joints 150 mm in direction of flow.
 - .1 Extend valley sheet minimum 150 mm under roofing sheets.
 - .2 At valley line, double fold valley and roofing sheets and secure with cleats spaced 450 mm on centre.

3.6 TOUCH-UP AND CLEANING

- .1 Remove grime and dirt from the metal roofing by dry wiping the panels as the material is erected.
- .2 Remove excess sealant with sealant manufacturer recommended solvent that will not harm finishes.
- .3 Leave metal roofing system in clean and neat condition.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 RCABC Roofing Practices Manual and Roofstar Guarantee Program.
- .2 ASTM A653/A653M-15, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A792/A792M-10(2015), Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .4 ASTM B32-08(2014), Standard Specification for Solder Metal.
- .5 ASTM B152 / B152M-13, Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.
- .6 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 ASTM B370-12, Standard Specification for Copper Sheet and Strip for Building Construction.
- .8 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
- .9 Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractors National Association, Inc (SMACNA).
- .10 CRCA Roofing Specifications Manual.
- .11 AA Aluminum Standards and Data, 2013 Edition.
- .12 AAMA 1402-09, Standard Specification for Aluminum Siding, Soffit and Fascia.
- .13 CSSBI S8-2008, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.

1.2 SUBMITTALS

- .1 Shop Drawings: Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascias, metal furring, and related work. Include details of continuity of air/vapour barriers at all tie-ins to adjoining systems.
- .2 Samples:
 - .1 Submit samples of each condition including cross-cavity flashing, sill, head, cap, saddle, etc.
 - .2 Submit samples of each type of material and colour to be used.
- .3 Product Data: Provide manufacturer's technical data for each type of material to be used.

- .4 Maintenance Data:
 - .1 Provide for inclusion in manual specified in Section 01 78 23 – Maintenance and Renewal Manual.

1.3 MOCK-UP

- .1 Assemble a mock-up of each condition, including cross-cavity flashing, sill, head, cap, saddle, etc. on site for review by the Departmental Representative.
- .2 Mock-up shall include all components of the system, including typical joints and connection hardware, and typical tie-ins to adjoining systems, all finished as specified.
- .3 Modify mock-ups as the Departmental Representative may direct to meet specified requirements.
- .4 Mock-ups may remain part of finished work.
- .5 Allow 24 hours for Departmental Representative's review of mock-ups before proceeding with work.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Do not expose Products to wetting or damage. Store neatly, properly stacked.
- .2 Transport, handle and store Products so as to prevent damage. Stack preformed Products in manner to prevent twisting, bending and rubbing.
- .3 Remove all units or components that are stained, watermarked, cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Protect finish and edges in accordance with manufacturer's directions.
- .5 Store material in accordance with manufacturer's directions.
- .6 Prevent contact of dissimilar metals during storage and protect from acids, flux, and other corrosive materials and elements.

Part 2 Products

2.1 SHEET METAL MATERIALS

- .1 Carbon Steel:
 - .1 Z275 galvanized steel sheet: to ASTM A653/A653M, commercial quality coating. Thickness: 24 gauge (0.6070mm).
 - .2 Finish:
 - .1 Prefinished steel with factory applied silicone modified polyester on primer, both paint and primer back cured. Include paint system coating to reverse side of coil stock to prevent corrosion of backside surfaces and uniform colour.

- .2 Performance Level: “CSSBI S8-2008. Coating thickness not less than 25 micrometres +/- 3 micrometres (1.0 mils +/- 0.1 mils).
- .3 Product: Perspectra Plus Series or equivalent.
- .4 Colour: The Departmental Representative will select colours from the manufacturer’s standard colour range.

2.2 ACCESSORIES

1. Underlay for Metal Flashing: refer to Section 07 65 16 – Self-Adhering Membrane.
2. Sealants: in accordance with Section 07 92 00 – Building Envelope Sealants.
3. Cleats and Starter Strips: of same material, and temper as sheet metal, minimum 50 mm (2”) wide x thickness same as sheet metal being secured.
4. Fasteners: of same material as sheet metal, corrosion resistant, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing and trim application.
5. Washers: of same material as sheet metal, 1.0 mm thick with rubber packings.
6. Solder: to ASTM B32, alloy composition 50% pig lead and 50% block tin.
7. Flux: commercial quality as recommended by sheet metal manufacturer.
8. Touch-Up Paint: as recommended by the prefinished material manufacturer.

2.3 FABRICATION

1. Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC and SMACNA details and specifications.
2. Form to maximum 2400mm (8ft.) lengths using one piece for each flashing section. Make allowance for expansion at joints.
3. Use flat-lock folded seams for all joints and splices of thru-cavity flashings. S-lock joints may be used if all flashing surfaces are sloped greater than 3:1.
4. Use standing seams for all joints and splices for cap flashings. Use flat-lock seams where cap flashings are accessible to occupants.
5. Hem exposed edges on underside 12 mm; mitre 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. Ends of thru-cavity flashing shall have 1/2" folded upturn, creating an end dam. Do no cut and caulk upturns.
8. Form metal flashing on a bending brake with shaping trimmed. Perform hand seaming on a bench, as far as practicable, with proper sheet metal working tools. Make angles of bends and folds for interlocking metal with full regard to expansion and contraction to avoid buckling and damage to metal.

9. Form flashings, copings and fascias to profiles indicated on Drawings and as required to complement and finish membrane roofing and wall systems.

2.4 SADDLE AND CAP FLASHINGS

- .1 Shop fabricate complete saddle flashing in one piece with soldered seams. Grind seams smooth, prime and shop paint to match sheet stock.

2.5 SCUPPERS

1. 4" copper Box Clamp Scupper by Menzies Metal. Complete with membrane clamping collar and 4" flange.
2. Form scuppers from copper in sizes and profiles indicated on Drawings.
3. Provide necessary fastenings.

Part 3 Execution

3.1 EXAMINATION

1. Examine surfaces to receive flashings. Notify the Departmental Representative of surfaces, which are considered unacceptable to receive the work of this Section

3.2 PREPARATION

1. Protect the work of other Sections from damage by the work of this Section.

3.3 INSTALLATION - GENERAL

1. Install sheet metal working accordance with applicable RCABC standards.
2. Use concealed fastenings throughout, except where approved by the Departmental Representative prior to start of the work.
3. Provide underlay under sheet metal; secure in place and lap joints 100 mm (4").
4. Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flashing joints using standing seams forming tight fit over hook strips.
5. Use flat-lock joints for all metal flashing except roof. S-pocket and standing seams are acceptable. Lock end joints and caulk with sealant.

3.4 COUNTER FLASHINGS

1. Install metal counter flashings as soon as possible after membrane flashings are in place and reviewed by the Departmental Representative.
2. Counter flashing shall have crimped bottom edge, stiffening break and shall extend at least 400mm (16") up verticals or as detailed on Drawings and extend down to horizontal plane of roof surface.
3. Where detailed on Drawings, turn top edge of flashing into walls, secure with lead wedge or friction fit pins into reglet and caulk at joint to wall.

4. Secure sections in S-pocket joints and allow sufficient tolerance for expansion and contraction between each piece.
5. Secure metal counter flashing a minimum of 300mm (12") above roof membrane. Use fasteners of sufficient length to penetrate at least 25mm (1") into substrate.

3.5 CAP FLASHINGS

1. Supply and install continuous metal starter strips, secure at 600mm o.c. (24" o.c.), maximum of 50mm above drip edge, with fastener of sufficient length to penetrate a minimum of 25mm (1") into the substrate.
2. Supply and install metal cleats at 600mm o.c. (24" o.c.) and as detailed. Use fastener of sufficient length to penetrate a minimum of 25mm (1") into substrate.
3. Form cap flashings to profiles shown on Drawings and ensure positive drainage to the interior roof surface areas.

3.6 REGLETS

1. Do not re-use reglets that are not of sufficient height. Cut new reglets at a suitable height as shown on Drawings) and a minimum of 13mm (1/2") wide and 19mm (3/4") deep.
2. For existing reglets more than 400mm (16") above the horizontal membrane surface, clean out and secure new metal flashing and caulk. Minimum height shall be 400mm (16") or as detailed on Drawings.

3.7 EAVESTROUGHS AND DOWNPIPES

1. Install eaves troughs in maximum 15m (50 ft.) lengths, and secure to building at 750 mm o.c. (30") with eavestrough fastener bracket with screw. Slope eaves troughs to downpipes. Provide at least one downspout per 15 m (50 ft.) of eavestrough length. Solder and seal joints watertight.
2. Install downpipes and provide goosenecks back to wall. Secure downpipes to wall with straps at 1800 mm (6 ft.) o.c.; minimum two straps per downpipe. Seal all nail penetrations at straps.
3. Connect downpipes to drainage system and seal joint with plastic cement. If drainage system is not accessible, install splash pans.

3.8 SCUPPERS

1. Install scuppers in accordance with applicable RCABC standards.

3.9 TOUCH-UP AND CLEAN-UP

1. Remove grime and dirt from flashing materials by dry wiping as the material is erected.
2. Remove all excess solder. Remove excess sealant with sealant manufacturer recommended solvent that will not harm finish.

3. Wipe off all hand prints, smudges, and other superficial stains.
4. Remove and replace all dented and damaged materials.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Self-adhering membranes as indicated on the drawings and as specified herein.

1.2 REFERENCE STANDARDS

- .1 CGSB 19-GP-14M - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

1.3 SUBMITTALS

- .1 Product Data: Provide data on material characteristics, performance criteria, and limitations.
- .2 Manufacturer's Installation Instructions: Indicating manufacturer's requirements and recommendations for preparation, installation, storage and handling.
- .3 Evidence of Applicator Qualifications: Submit evidence of applicator's qualifications as specified in 1.4 Quality Assurance before commencing work of this Section.
- .4 Inspection Reports: Submit inspection reports from membrane manufacturer's technical representative to confirm site visits as specified in 1.4 Quality Assurance within five days after each site visit. Indicate percentage completion with each report. Confirm that all components of the system are compatible with adjacent materials.

1.4 QUALITY ASSURANCE

- .1 Obtain all materials from a single manufacturer.
- .2 All membrane work shall be carried out by a specialist applicator, approved by the membrane manufacturer, who can substantiate successful installation of similar membrane systems over a minimum period of five years.
- .3 A technical representative from the membrane manufacturer shall ensure compliance with the manufacturer's directions. The technical representative shall be present when the applications start and shall make periodic inspections during applications, as required.

1.5 MOCK-UP

- .1 Construct typical exterior wall, 3.0 m long by 3.0 m wide, incorporating window and door frame and sill, insulation, building corner condition, and junction with roof vapour retarder; illustrating materials interface and seals.
- .2 Locate where directed by Departmental Representative.
- .3 Allow for review of mock-up by the Departmental Representative before proceeding with work of this Section.
- .4 Mock-up may remain as part of completed work

1.6 AMBIENT CONDITIONS

- .1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.
- .2 Maintain temperature and humidity recommended by the Product manufacturer before, during and after installation.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in their original packaging in undamaged condition, sealed with labels intact, having manufacturer's name, brand, weight, and applicable reference standards clearly shown.
- .2 Protect materials from damage, weather and store in a dry place.
- .3 Handle materials in accordance with the manufacturer's recommendations. Promptly remove damaged or deteriorated materials from site.

Part 2 Products

2.1 WALL MEMBRANE FLASHINGS

1. Self-adhering SBS rubberized asphalt compound integrally laminated to polyethylene or polypropylene film. Acceptable Products:
 - .1 Sopraseal Stick 1100T by Soprema.
 - .2 Blueskin SA by Henry.
 - .3 Jiffyseal 140/60 by ProtectoWrap Company.
 - .4 Or approved alternative.

2.2 WINDOW SILL FLASHINGS

1. Self-adhering SBS rubberized asphalt compound integrally laminated to polyethylene or polypropylene film. Acceptable Products:
 - .1 Flashing Tape by Dupont
 - .2 Jiffyseal 140/60 by ProtectoWrap Company.
 - .3 Or approved alternative.

2.3 HIGH TEMPERATURE FLASHING

1. Self-adhering SBS rubberized asphalt compound integrally laminated to polyethylene or polypropylene film. Acceptable Products:
 - .1 Lastobond Shield HT by Soprema.
 - .2 Blueskin PE 200 HT by Henry
 - .3 Or approved alternative.

2.4 ACCESSORIES

1. Primers, Mastics, Sealants, Liquid Membrane, Control Joint Materials: as required or recommended by membrane manufacturer.

Part 3 Execution

3.1 PRE-INSTALLATION MEETING

1. Convene one week prior to commencing work of this Section.

3.2 EXAMINATION

1. Verify that surfaces and conditions are ready to accept the work of this Section.
2. Report any unsatisfactory conditions or surfaces to the Departmental Representative in writing. Starting work shall imply acceptance of surfaces and conditions.
3. Take all necessary measurements and levels at the building. Lay out the work accurately to fit the conditions at the building and adjacent work.
4. Notify the Departmental Representative of any variations beyond acceptable tolerances in the substrate or in the adjacent work.

3.3 PREPARATION

1. Prepare all surfaces to receive membrane, including substrates, joints, cracks, and coves, in accordance with the membrane manufacturer's directions.
2. Ensure that all substrate surfaces are smooth, dry and firm. Remove any frost, ice, loose particles, ridges, laitance, cracks, grease, asphalt, oil and other foreign matter which could prevent adhesion of the membrane to the substrate.

3.4 PRIMING

1. Clean and prime substrate surfaces to receive adhesive and sealants in accordance with membrane manufacturer's instructions.
2. Ensure substrate and ambient air are within manufacturer recommended temperature range for application.
3. Apply primer uniformly at temperature and rate recommended by the primer manufacturer.
4. Open time of the primer to be in accordance with the primer manufacturer's recommendations.

3.5 MEMBRANE APPLICATION

1. Application of membrane, including temperature limitations, curing requirements and all other application procedures shall be in accordance with membrane manufacturer's written directions.
2. Cut and seal membrane around protrusions to form tight seal.

3. Apply trowelled bead of mastic to all terminations at end of each day's work.
4. Inspect membrane thoroughly before being covered and make any corrections immediately. Repair misaligned or inadequately capped seams, punctures, or other damage by patching and sealing in accordance with membrane manufacturer's directions.
5. At all detail areas, take extra care to ensure continuity of the membrane.
6. Apply membrane in a "shingle", to direct water in a downwards fashion with joints lapped a minimum 100mm (4").
7. Reinforce all corners with second ply of membrane.
8. Extend all membrane patches a minimum of 150mm (6") from repair location or penetration. Seal all around patches with tooled mastic.
9. Seal all side laps and all reverse laps with mastic.
10. Bridge all joints or gaps wider than 6mm (1/4") with galvanized steel sheet, wood or other suitable backing and apply 300mm (12") piece of membrane over joints prior to application of the field membrane.
11. Coordinate installation of membrane with other related work to minimize exposure of membrane.

3.6 FIELD QUALITY CONTROL

1. Prior to the membrane being covered, notify the Departmental Representative for review.

3.7 PROTECTION

1. Repair, remove and clean all mastic, primer or other smears on exposed finished surfaces or surfaces to be subsequently finished. Clean off immediately to the satisfaction of the Departmental Representative. Protect all adjacent surfaces from damage due to membrane operations.
2. Protect from damage any membrane that is installed in a high traffic area.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM C679 - Standard Test Method for Tack-Free Time of Elastomeric Sealants.
- .2 ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
- .3 ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- .4 ASTM C834 – Standard Specification for Latex Sealants
- .5 ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications
- .6 ASTM C920 - Elastomeric Joint Sealants.
- .7 ASTM C1193 - Standard Guide for Use of Joint Sealants.
- .8 ASTM C1248 - Standard Test Method for Staining Porous Substrate by Joint Sealants.
- .9 ASTM C1330 - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .10 ASTM C1472 - Standard Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width
- .11 ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
- .12 ASTM D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
- .13 ASTM D2202 - Standard Test Method for Slump of Sealants.
- .14 Sealant, Waterproofing and Restoration Institute (SWRI) publication, *Sealants: The Professionals' Guide 2013*.

1.2 SUBMITTALS

- .1 Samples:
 - .1 Submit samples of each type of material and colour to be used and to facilitate colour selection.
 - .2 Cure samples under equivalent conditions to job site, before submission.
- .2 Submit letters from the sealant manufacturer's representative that all areas and surfaces were inspected and found satisfactory to receive materials, in accordance with sealant manufacturer's requirements.
- .3 Maintenance Data:
 - .1 Submit data covering the care, cleaning and maintenance as per Section 01 78 23 – Maintenance and Renewal Manual.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Leave one unopened tube of each sealant type and colour on site upon completion of work.

1.4 QUALITY ASSURANCE

- .1 Sealant manufacturers representative shall review site conditions, joint design and installers qualifications. Report unsatisfactory conditions to the Departmental Representative.
- .2 Representative shall check container labels, random inspect preparation of substrate materials and perform random testing of installed work in at least 10 locations.
 - .1 Cut test locations to be 150 mm long.
 - .2 Certify thickness, hardness and surface finish conforms to intended design.
 - .3 Report to the Departmental Representative.

1.5 QUALIFICATIONS

- .1 Perform the work of this Section using skilled mechanics having at least five years experience, and trained and competent in use of sealant materials.

1.6 MOCK-UP

- .1 Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, caulking and sealant.
- .2 Construct mock-up in location directed by the Departmental Representative.
- .3 Joint to be size, shape and depth of joints applicable to the work, complete with back-up material, primer, and sealant.
- .4 Mock up may be part of finished work.
- .5 Allow 24 hours for review of mock-up by Departmental Representative before proceeding with sealant work.
- .6 Test sealant in contact with samples of materials to be caulked to ensure that proper adhesion will be obtained and no staining of any materials will result. Prepare joint samples at the site of each type of sealant for each joint condition.

1.7 PERFORMANCE REQUIREMENTS

- .1 The sealant system shall satisfy the following requirements for the duration of the warranty period:
 - .1 Totally waterproof, flexible and thermally compatible with the substrate under applicable service conditions.
 - .2 Provide a weathertight seal that does not allow moisture penetration.
 - .3 Withstand active cyclical movements of 100% extension and 50% compression of the joint width and remain bonded and watertight.
 - .4 Shall not debond, crack or craze.

.5 Shall not leak.

.2 Reference to products does not relieve the manufacturer of responsibility to comply fully with all specified criteria.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, handle, store and protect materials as recommended by materials manufacturer.

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

.3 Store material in heated conditions during winter work.

1.9 FIELD CONDITIONS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.3 Polyurethane sealant and substrate materials shall be minimum 4°C. Silicone sealants to be minimum -29°C.

.4 If applying sealants below 4°C, special care must be taken to ensure that substrate surfaces are clean and dry. Further, the applicator is to consult with the sealant manufacturer and follow their recommendations.

.5 Ventilate work area as specified in Section 01 10 01 – General Requirements.

Part 2 Products

2.1 MATERIALS

.1 Joint Cleaner: Xylol, methylethylketone, alcohol, or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

.2 Primers: Types recommended by sealant manufacturer.

.3 Joint Back-Up: Round closed cell foam, extruded polyolefin, Shore A hardness of 20, tensile strength 140 to 200 kPa, oversized 30-50%, compatible with sealant and primer, non-adhering to sealant, and non-gassing.

.4 Bond Breaker: Pressure-sensitive plastic tape that will not bond to sealants.

.5 Vent/Weeping tubes: non-metallic, 6mm inside diameter minimum.

- .6 Sealants:
 - .1 Category 1 – One component Polyurethane, conforming to ASTM C920 Type S, Grade NS, Class 100/50, Use T, NT, G, A, O
 - .1 Sikaflex 15MLM by Sika
 - .2 Or approved alternative.
 - .2 Category 3 - Single component synthetic rubber, conforming to CAN/CGSB 19.21 M87
 - .1 Acoustical/ Curtain Wall Sealant by Tremco Ltd.
 - .2 Or approved alternative.
 - .3 Category 4 – Multi-component polyurethane conforming to ASTM C920 Type M, Grade NS, Class 100/50, Use T, NT, M, A, O
 - .1 Dymeric 240 by Tremco Ltd.
 - .2 Or approved alternative.
 - .5 Category 5 – One part silicone conforming to ASTM C920 Type S, Grade NS, Class 100/50, Use NT, M, G, A, O
 - .1 Sikasil WS-290 by Sika.
 - .2 Or approved alternative.
 - .6 Colour of Sealants: Selected by the Departmental Representative to match adjacent finishes. Contractor to provide colour samples to facilitate selection.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine surfaces before commencing work of this Section.
- .2 Installation of sealant implies acceptance of surfaces. Notify the Departmental Representative in writing of any existing conditions that may affect the bonding or performance of the sealant for resolution before installation of materials.

3.2 PREPARATION

- .1 Ensure ambient and existing site conditions are suitable for installation of work of this Section, as recommended by the manufacturer.
- .2 Ensure all existing sealant and extruded tapes are removed and surfaces prepared and primed in accordance with the manufacturer's recommendations.
- .3 Prepare surfaces in strict accordance with the manufacturer's recommendations, including preparation and smoothing of rough surfaces and detailing of cracks, joints and voids.

- .3 Ensure joint surfaces are sound and free of all moisture, dust, oils and other materials that may adversely affect sealant bond.
- .4 Minimum standard of cleaning for all surfaces shall be wire brush, or equivalent to remove all traces of existing sealant and to expose clean substrate.
- .5 Clean metal flashings and mullions so as not to damage surface finishes.
- .6 On non-porous substrates: use a two-wipe method when cleaning. The first wipe shall contain the solvent, followed immediately by the second wipe with a clean cloth to collect any re-deposited material loosened by the first wipe.
- .7 After cleaning, ensure that joints are dry, dust free and frost free before applying sealant.
- .8 Apply no primer or first coat until surface preparation has been inspected and accepted in writing by a representative of the sealant manufacturer.
- .9 Examine joint sizes and correct to achieve depth ratio of one-half of joint width with minimum width and depth of 6.0 mm and maximum width of 25 mm.
- .10 Install joint back-up to achieve correct joint depth.
- .11 Where necessary to prevent staining, mask adjacent surfaces before priming and caulking.
- .12 Apply bond breaker tape where required, in accordance with manufacturer's instructions.
- .13 Prime sides of joints in accordance with manufacturer's instructions immediately before caulking.
- .14 Install interior splines before caulking of exterior glass bead.

3.3 APPLICATION

- .1 Apply sealants in accordance with manufacturer's instructions. Apply using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
- .2 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, and embedded impurities. Tool surface neatly to produce slight concave joint.
- .3 Do not use application procedures that result in toxic fumes or flammable solvents collecting and endangering workers or building occupants.
- .4 Category 1, 4, and 5: apply sealant to following exterior locations.
 - .1 Joints between window or door frames to adjacent building components.
 - .2 Around perimeter of exterior wall penetrations (window framing to cladding).
 - .3 At junctions of dissimilar material (i.e., frame construction to concrete construction).

- .4 Where detailed.
- .5 Category 3 : apply sealant to the following locations:
 - .1 Around perimeter of wall and penetrations for "concealed" acoustical and air/vapour barrier applications.
- .6 Category 4 : apply sealant to the following locations:
 - .1 Building control and expansion joints except where preformed joint inserts are used.
- .7 Category 5 apply sealant to the following locations:
 - .2 At perimeter joint of glass to window framing as “cap bead”.
- .8 Cure sealants in accordance with sealant manufacturer’s instructions.
- .9 Cure sealants in accordance with sealant manufacturer’s instructions.

3.4 FIELD QUALITY CONTROL

- .1 Provide safe access for Departmental Representative to perform periodic reviews of various phases of the work of this Section.
- .2 Notify Departmental Representative, and any testing agency that may be designated by the Departmental Representative, 24 hours in advance of work to be performed under this Section.
- .3 Repair test locations.
- .4 Tests may be performed at the Departmental Representative’s discretion to confirm in-situ material thickness.

3.5 CLEANING AND PROTECTION

- .1 Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings, using recommended cleaners as work progresses. Remove masking tape after tooling of joints.
- .2 Protect caulked joints until sufficiently cured.
- .3 Protect completed work of this Section from staining or contamination.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Furnish all labour, materials, equipment, and services required for the design, fabrication, supply and installation of insulated steel doors as shown on the drawings and as specified. Furnishment to include, but not be limited to the following:
 - .1 Exterior doors, including weatherstripping and thresholds.
 - .2 All glazing accessories including gaskets, thermal breaks, setting blocks, and sealants.
 - .3 All necessary reinforcing members, brackets, anchors, fasteners and other accessories as required to meet the structural requirements of the installation and specifications in this section.
 - .4 Shop applied primer and finish painting of all door parts.
 - .5 All perimeter closures, membranes, sealants, flashings, and trim required to integrate the door assemblies with other cladding and finishing materials, and to ensure continuity of the air/vapour/moisture seal of the building envelope.
 - .6 Assessment of the alignment of the existing façade elements as required to allow design and layout of the work in this section.
 - .7 All fastening of the door assemblies to the rough openings.
 - .8 Reinstall all security hardware from existing doors.

1.2 REFERENCE STANDARDS (Most recent version unless noted otherwise)

- .1 ASTM A525M – General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric).
- .2 ASTM A526 – Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- .3 ASTM A527 – Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
- .4 ASTM A568 – General Requirements for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- .5 Canadian Steel Door and Frame Manufacturers Association (CSDFMA).
- .6 CAN/CGSB 82.5, Insulated Steel Doors.
- .7 CAN/CSA-G40.21, Structural Quality steel.
- .8 CAN/CGSB-51.20, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .9 NFPA No.80 – Fire Doors and Windows

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 This is a performance specification issued in conjunction with the drawings for the work. The drawings show the general arrangement of the finished work and these specifications describe the minimum requirements of the finished system. The Contractor is responsible for designing and furnishing a system that will fulfill the requirements of the specifications and drawings including items which may not be shown or specified but are required for performance of the system.
- .2 Materials, fabrications, attachments, accessories, assembly and performance, other than thermal performance, shall meet or exceed applicable requirements as specified herein.
- .3 Labels and trademarks, including applied labels, shall not be visible on the finished work, except identification of safety glass as required by code.
- .4 The system shall be fabricated and installed square, level and plumb as follows:
 - .1 Plumb to within 3 mm of vertical over the height of each unit.
 - .2 Within 3.0 mm of level relative to a datum established for frames at the same floor.
 - .3 Within 1.5 mm of level relative to an adjacent frame.
 - .4 Each frame shall be within 3.0 mm of square when measured across the diagonals.
 - .5 Clearances required for installation should be considered and indicated on the shop drawings.
 - .6 All movements of the window system shall be noiseless.
- .5 Weather Tightness
 - .1 Air Infiltration – Air infiltration around edges of door panels shall not exceed $11.6 \times 10 \text{ m}^3/\text{s}$ for each metre of crack length when tested in accordance with ASTM E283, at a static air pressure of 75Pa.
 - .2 Water Resistance – No water shall pass the interior face of the door unit when tested in accordance with ASTM E331, except that the air pressure differential shall be zero and the test duration shall be 5 minutes.
- .6 Durability
 - .1 The doors, frames and integral seals shall be designed to have an expected service life of 10 years. All seals, gaskets, corrosion protection, coatings and attachments are expected to be serviceable at the end of this service period.
 - .2 The glazing shall have a guaranteed service life of 5 years. Any glazing failing to meet this service life shall be removed and replaced at no cost to the Departmental Representative under guarantee by the Contractor. Failure of any glazing shall be deemed to occur if any of the following are noted:
 - .1 Chipping, cracking, or breakage of glass panes occurring due to manufacturing defects or under specified service conditions.

1.4 SUBMITTALS

- .1 Submittals to be made in accordance with Section 01 33 00 - Submittals.
- .2 Product Data: Submit catalogue details for each type of door and framing system illustrating profiles, dimensions and methods of assembly, installation procedures, recommendations and data that products have been tested and comply with performance requirements.
- .3 Samples: If requested, make the following samples available for Departmental Representative review at least one week prior to shop drawing preparation:
 - .1 One (1) door and frame.
- .4 Installation Manual: The manufacturer shall provide a copy of the installation manual for the system. An additional copy of this manual shall be kept on site for the use of the Contractor and personnel reviewing the installation work.
- .5 Maintenance Data: Provide in accordance with Section 01 78 23 – Maintenance and Renewal Manual, the following data for incorporation into specified maintenance manual:
 - .1 A recommended inspection procedure and schedule and component replacement schedule.
 - .2 Data for cleaning and maintenance of framing finishes, glazing and hardware including materials and methods to be used that will not harm or stain the glass, aluminum, rubber or sealant components of the assembly, and reglazing procedures and accessories, including point of purchase information for any proprietary glazing components required during the procedure.

1.5 MOCK-UPS

- .1 Provide and install one sample door as a mock-up for Departmental Representatives review and acceptance prior to delivery of remaining doors. Type and location selected by the Departmental Representative.
- .2 Sample door and reviewed installation shall be in accordance with project requirements and may be included as part of the completed work.
- .3 Sample door shall be a typical operable unit including, but not limit to specified mullions, glazing, surface finishes and all hardware.
- .4 Mock-up location shall include all surrounding building envelope components including but not limited to interior finishes, vapour retarder, framing, moisture barrier, sealants, strapping, flashings, trims and cladding. Plywood sheathing is an acceptable temporary alternate replacement for stucco cladding.
- .5 Manufacturer shall review, verify and provide written acceptance to verify compliance for installation and warranty.

1.6 PERFORMANCE VERIFICATION TESTING

.1 General Performance Testing Requirements

- .1 Air leakage testing is to be conducted in accordance with ASHRAE 90.1 2016 standards by a qualified Agency engaged by the Contractor. Air leakage shall not exceed 1.02 L/s/m² at a pressure of 75 Pa.
- .2 All pre-delivery and in situ testing, including re-testing, shall be paid for directly by the Contractor.
- .3 All coordination with the Testing Agency shall be the responsibility of the Contractor. Contractor to ensure adequate notice is provided to all parties prior to scheduling testing.
- .4 The Testing Agency will distribute written results of all tests within three days of completing testing.
- .5 Contractor to engage a Testing Agency experienced in the work required. Preference is given to an Agency located within 2 hours of the project location.

1.7 QUALITY ASSURANCE

- .1 Conform to requirements of Canadian Steel Door and Frame Manufacturers Association standard.
- .2 Sealed insulation unit manufacturer to be a member in good standing of IGMA.
- .3 Glass and glazing work under this section to conform to IGMA standards.
- .4 Manufacturer, fabricator and installation contractor to be a member in good standing of GCABC and have a minimum of 5 years uninterrupted experience in successfully carrying out projects of similar size and shall employ suitable qualified tradespersons with at least five (5) consecutive years experience in this type of work. Contractor to document past experience on request.
- .5 Contractor to ensure all safety hardware and operable hardware is functioning upon temporary and final installation.
- .6 Fire rated frame construction to conform to CAN4 S105-M.
- .7 Installed frame and door assembly to conform to NFPA No.80 for fire rated class indicated on drawings.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials so as to avoid damage, following the recommendations contained in AAMA publication CW-10, "Care and Handling of Architectural Aluminum from Shop to Site".
- .2 All delivered products shall be stored on site in a safe and secure location that is inaccessible to residents or general public.
- .3 Stack frames vertically on edge so that water cannot accumulate on or within materials. Use wood, cork, or plastic shims between components to provide for water drainage and air circulation.

- .4 All hardware shall be installed prior to temporary and final installation.

1.9 PROTECTION

- .1 Take all precautions necessary to protect materials, before and after installation, from lime, mortar, water run-off from concrete or copper, careless handling of tools, weld spatter, acids, roofing components, solvents, abrasive cleaners, and other items that could damage the glass surfaces and aluminum finishes. Do not rely on protective plastic films to protect materials.
- .2 Protect work of other trades as necessary from damage resulting from work of this section. Damage caused by this contractor shall be corrected and made good at no expense to the Departmental Representative.

1.10 SITE CONDITIONS

- .1 Inspect, measure and survey all areas affecting work before commencement of installation. Surfaces that are considered not acceptable to receive the work of this section must be reported to the general contractor/project manager. The commencement of work shall imply the acceptances of previous construction.
- .2 Do not install any aluminum work or glazing until all nearby welding, grinding, sandblasting, waterproofing, mortar work and acid etching are complete.
- .3 Apply sealants and other materials affected by temperature, humidity and weather in general, at a time that is recommended by the manufacturer of these components.

1.11 SCHEDULING/COORDINATION

- .1 Co-ordinate with Sub-contractors of adjoining trades during preparation of shop drawings and field installation. The continuity of all air/vapour seals at areas of adjoining trades must be ensured.

1.12 WARRANTY

- .1 Work included in this section to be free of defects and deficiencies in materials and workmanship, and continue to perform satisfactorily for a period of two years from certified date of Substantial Performance of the Work.
 - .1 Satisfactory performance means compliance with the performance criteria and the testing and construction standards of this specification, and with the reviewed shop drawings. This includes the performance of finishes, hardware, glass and glazing materials, structural attachment, air, vapour and water seals, sealants and flashings.
 - .2 Correct all deficiencies that appear during the warranty period, including removal and replacement of failed sealed insulating units, at no cost to the Departmental Representative.
- .2 Obtain, on behalf of the Departmental Representative, copies of standard product warranties in excess of one year, from the respective manufacturers.
- .3 All on site modifications to window assemblies are to be in accordance and shall have written approval from the Manufacturer and shall not compromise specified Warranties.

Part 2 Products

2.1 MATERIALS

- .1 Sheet Steel: 24 gauge galvanized steel, cold rolled galvanized steel conforming to ASTM A 525M. Paint film thickness is in addition to the preceding minimum total thickness value.
- .2 Core: Expanded polystyrene to CAN/CGSB-51.20, density 16 to 32 kg/m.
- .3 Fasteners: As specified by door manufacturer.
- .4 Primer: baked-on enamel coating, to CAN/CGSB-1.132M (for galvanized material).
- .5 Finish: Thermosetting epoxy. The Departmental Representative will select up to two (2) colours from the manufacturer's core colour range.
- .6 Exterior Frames: appropriate to grade and model of door.
- .7 Weatherstripping: Weatherstrip shall be of a material that is resistant to deterioration by weathering and aging and shall be compatible with associated materials. Open cell plastic foam shall not be used. Surface-applied, glued-on weatherstrip is not acceptable. Flexible vinyl weatherstrip shall conform to CGSB 41-GP-20M. Weatherstrip shall be mechanically secured in position and shall be replaceable without the aid of tools specially designed for this purpose.
- .8 Thresholds: Extruded aluminum with resin thermal break feature. Width to match sill curb width. Profile configurations to be as detailed (outward swinging and inward swinging).

2.2 DOOR TYPE AND CLASSIFICATION

- .1 Swing Type: 1 insulated panel steel doors; shall be installed at locations indicated. Sizes of doors shall be as indicated. Include all frames and hardware.
- .2 Approved Type:
 1. Shanahans
 2. Fleming Doors
- .3 Steel doors shall be to manufacturer's standard exterior door, with polystyrene board core insulation.

2.3 HARDWARE

- .1 Exposed Hardware Components: metal, in finish to match existing. Door and frames shall be fully prepared for locks and strikes in conformance with ANSI A 115.
- .2 Hardware exposed to exterior environment with sash in closed and open positions shall be corrosion-resistant.
- .3 Hardware shall be screw attached with screws engaging tapped holes in reinforcing.
- .4 Locks: to match function type of existing.
- .5 Hardware Reinforcement: conform to NAAMM / HMMH 840 "Guide Specification for Installation and Handling of Hollow Metal Doors & Frames".

2.4 FABRICATION AND MANUFACTURE

- .1 **Workmanship:** All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed references and standards and/or as specified herein. Work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and adjoining building component tolerances and design criteria. All forming, welding and cutting operations shall be done prior to finishing.

All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, indentations, waves or flaws of any nature impairing strength or appearance; fitted with proper joints and intersections and with specified finishes. All members shall be extruded unless otherwise indicated on the drawings and shall be securely engaged into adjacent components. Extrusions shall be toleranced to eliminate any edge projection or misalignment at joints.

Expansion joints within framing shall be so designed and constructed to provide noiseless and free movement, and be and remain, permanently watertight.

No field forming, cutting and/or alteration of framing members will be allowed. All framing members will be shop fabricated and finished. No unfinished surfaces will be permitted on exposed surfaces.

- .2 **Protection of Metals:** Provide suitable protecting against galvanic action wherever dissimilar metals are in contact, as applicable.
- .3 **Joints in Metal Work:** All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise required, shall be accurately fitted, rigidly secured with contact tolerance less than 1mm and sealed watertight. Where two or more sections of metal are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any pointing materials.
- .4 **Shop Assembly:** wherever practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily assembled in the shop and marked before disassembly and shipping.
- .5 **Fasteners:** All fasteners, connectors, anchors including washers and accessory items shall be scheduled and designated by the door manufacturer.
- .6 **Welding of Steel to Conform to CSA W59-M84:** Welders to be fully approved by the CWB and comply with CSA W47.1-83, Division 3.

Part 3 Execution

3.1 CO-ORDINATION

- .1 Verify all measurements and dimensions of supporting structure by field measurement. Co-ordinate the installation of anchors and fixings with the appropriate trade as well as the sealing between work of this section and other sections.

- .2 Co-ordinate the delivery of glass and other materials so as not to interfere with the work of other trades on site.

3.2 ERECTION

- .1 All vertical members shall be plumb, all horizontal members shall be level; all sections shall be set in perfect alignment throughout and be securely and rigidly fastened in place.
- .3 Accurately fit and frame components carefully to produce continuity of line and design. Provide flush and tightly fitted joints and connections.
- .4 Hang doors, matching to proper frames, and using hardware scheduled.
- .5 Shim butts as required using metal shims to provide correct clearance, fit and operation. Shims by door manufacturer.
- .6 Adjust as required for correct and free operation.
- .7 Clearance between door and frame shall not exceed 3.18mm (1/8”).

3.3 ANCHORS AND SUPPORTS

- .1 Install all anchor bracket assemblies, anchor brackets, anchor straps, shims, stud bolts, nuts, washers, splice plates, bracing, etc. as required to be attached to and/or built into building frame as required for support of the door assembly.

3.4 CLOSURES, FLASHINGS AND TRIM

- .1 Furnish and install closures, flashings and trim required in connection with door system required to make the work watertight, whether or not such flashings are indicated on the drawings or details.
- .2 Flashings and closures shall be formed to suit the various conditions as detailed and as required.
- .3 Metal shall be supplied as long as practicable in order to provide the minimum number of joints.

3.5 GASKETS

- .1 Install all gaskets, tapes, weatherstripping and sealants as required to provide watertight, weathertight and airtight joints.
- .2 Joints and spaces to be sealed shall be thoroughly cleaned of foreign matter and be thoroughly dry before applying gaskets or sealants.

3.6 PROTECTION MARKINGS

- .1 Material for protection markings on glass such as adhesives for manufacturer's labels shall be either neutral or slightly acidic. In no case shall such materials be alkaline. Any staining of glass or other surfaces by such alkaline materials will be cause for rejection.

3.7 ADJUST AND CLEAN

- .1 Contractor shall be responsible for preventing accumulations of foreign materials such as dust and particulates into the glazing work by other processes occurring on site. The work must be adequately protected daily against any such detrimental soiling in coordination with the General Contractor

- .2 Upon completion of the work of this section, remove protective coverings and paper labels from exposed surfaces and clean surfaces of all dust, smears, marks and discoloration. Cleaning shall be in accordance with applicable provisions of listed standards and the requirements of the manufacturer.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Furnish all labour, materials, equipment and services necessary for the design, fabrication, supply and installation of the glass and aluminum curtain wall system as indicated on the drawings and as hereinafter specified. The work of this section shall include, but shall not necessarily be limited to, the following:
 - .1 Design, fabrication, supply and installation of completely pre-finished, glazed, curtain wall system. The curtain wall as shown on the drawings encompasses the following basic systems. These systems are:
 - .1 Anodized, thermally broken, structurally glazed, triple glazed curtain wall
 - .2 Vestibule automatic door
 - .2 Checking of building lines and levels as required for the proper layout and installation of all work included in this section.
 - .3 Supply and installation of all aluminum extrusions, insulation, sheet air/vapour barriers, elastomeric gaskets and sealants, and related appurtenances required to make this portion of the building envelope an airtight assembly.
 - .4 Supply and installation of all jointing materials and sealants in order that the continuity of the systems air/vapour barrier be attained at all interfacing and adjoining work. Work does not include building insulation nor main membrane air/vapour barrier.
 - .5 Supply and installation of all reinforcing, bracing, anchoring and connecting pieces, members or assemblies required to attach the work of this Section to the building structure and required for the structural integrity of the curtain wall.
 - .6 Shop painting of all steel shapes and ferrous metal used in attachment or reinforcing of curtain wall and field painting after steel shapes are installed.
 - .7 Installation of hermetically sealed glazing units and used in glazing systems, all complete with glazing gaskets, sealants, setting blocks, edge blocks, glazing tapes, backer rods and related items.
 - .8 Supply and installation of back panels, insulation and closures within glazing systems.
 - .9 Supply and installation of aluminum doors/frames, all complete with associated hardware as shown within the curtain wall system.
 - .10 Supply and installation of all prefinished aluminum copings and flashings at all glazing systems.
 - .11 Supply and installation of on-site mock-up panel for the curtain wall system all complete with associated glass, seals, mullions, etc. so as to demonstrate a complete installation including connections to the building envelope.

- .12 Quality assurance site testing.
- .2 Work of this Section does not include the following;
 - .1 Supply and installation of aluminum storefront door systems (automatic sliding doors) all complete with associated door frames and hardware as shown within curtain wall system.
- 1.2 REFERENCE STANDARDS (MOST RECENT VERSION UNLESS NOTED OTHERWISE)**
 - .1 British Columbia Building Code (BCBC)
 - .2 Aluminum Association Designation System For Aluminum Finishes
 - .1 DAF 45, Designation System For Aluminum Finishes.
 - .3 American Architectural Manufacturers Association (AAMA).
 - .1 AAMA CW-DG-1, Aluminum Curtain Wall Design Guide Manual.
 - .2 AAMA CW-10, Care and Handling of Architectural Aluminum From Shop to Site.
 - .3 AAMA CW-11, Design Wind Loads for Buildings and Boundary Layer Wind Tunnel Testing.
 - .4 AAMA T1R-A1, Sound Control for Fenestration Products.
 - .5 AAMA 501, Methods of Test for Exterior Walls.
 - .6 AAMA 503, Voluntary Specification for Field Testing of Metal Storefronts, Curtain Wall and Sloped Glazing Systems.
 - .7 AAMA 611, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
 - .8 AAMA 612, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
 - .9 AAMA 2603, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - .10 AAMA 2604, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - .4 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A36/A36M-[103a], Specification for Carbon Structural Steel.
 - .2 ASTM E-90, Standard Method for Laboratory Measurement of Airborne Sound Transmission.
 - .3 ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

- .4 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .6 ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 ASTM B221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .8 ASTM E283, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .9 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .10 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .11 ASTM E413, Classification for Rating Sound Insulation.
- .12 ASTM E1105, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .5 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 1.108, Bituminous Solvent Type Paint.
 - .2 CAN/CGSB-12.20, Structural Design of Glass for Buildings.
 - .3 Canadian Standards Association (CSA International).
 - .4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members.
 - .7 CAN3-S157-M, Strength Design in Aluminum.
 - .8 CSA W59.2-M, Welded Aluminum Construction.
- .6 Environmental Choice Program (ECP).
 - .1 CCD-45, Sealants and Caulking Compounds.
 - .2 CCD-47, Surface Coatings.
 - .3 CCD-48, Recycled Water-Borne Surface Coatings.

- .7 Society for Protective Coatings (SSPC).
 - .1 SSPC - Paint 20 Zinc Rich Coating.
 - .2 SSPC - Paint 25 Alkyd, Zinc Oxide Linseed Oil and Primer for Use Over Hand Cleaned Steel Type 1 and Type 2.

1.3 DESIGN RESPONSIBILITY

- .1 The design, fabrication and erection of the curtain wall system as required to meet these performance specifications shall be the complete responsibility of the Contractor. Because of this required design responsibility, the final reviewed shop drawings shall form part of the contract documents.
- .2 The design intent for the curtain wall system, indicated by the details is to provide systems which incorporate insulated sealed flush glazed lights of glass completely retained within an aluminum framing system where indicated.
- .3 The details shown are included for the purpose of indicating the preferred profiles and dimensions necessary to achieve the design intent and are not intended to eliminate other design proposals. Minor dimension adjustments to that shown may be made in the proposed design in the interest of fabrication or erection methods or techniques, the weatherability factor, or the ability of the design and performance requirements specified, provided that the design intent and the intent of the specifications are maintained.
- .4 The method of assembly, reinforcing and anchorage of the curtain wall is schematic and shows general intent only. Location and methods of providing same shall be this contractor's responsibility, who shall design the assembly, reinforcing and anchorage to suit each specific condition in an acceptable manner to comply with the design and performance requirements specified herein.
- .5 Design proposals shall be submitted, upon request after tender close, for review by the Departmental Representative in accordance with Clause 1.6 - Submittals.
- .6 Design proposal submissions which follow exactly the details indicated on the drawings will not relieve this contractor of responsibility for the design, fabrication, erection and performance of the curtain wall system.
- .7 The Departmental Representative's review of any and all items designated in this specification will be done with the understanding and assurance that this Contractor is fully responsible for the performance of all work covered in this section.

1.4 DESIGN AND PERFORMANCE CRITERIA

- .1 Design, fabricate and install component parts of the curtain wall system as listed below. The critical dimensions are to match the existing openings.
 - .1 The centre to centre spacing of vertical and horizontal mullions of the curtain wall framing.
 - .2 The width, depth and profile of the exterior cap of the curtain wall systems.

- .3 The profile of the interior mullion sections of the aluminum framing sections for both capped and structural silicone face (capless) system. Refer to elevations for extent of each type.
- .4 The dimension from the finish concrete floor level to top of curtain wall sill at floor levels.

Minor dimension adjustments, as described in Clause 1.4, will be allowed.

- .2 The design of the curtain wall system shall accommodate the profile and shape of adjoining building components.
- .3 Aluminum curtain wall system shall be thermally broken.
- .4 Curtain wall aluminum framing shall incorporate a pressure equalized “rain screen” system with a complete air and vapour seal, allowing any water entering the framing to drain to the exterior and also allow air into the pressuring chamber to provide nearly instantaneous pressure equalization. Vents and drain holes (orifices) shall be inconspicuously located and in such positions as not to contribute to staining, streaking or marking of the glass or mullions. Vertical and horizontal compartmenting must be incorporated in the design of the system, due to the spatial distribution of wind pressures.
- .5 The curtain wall framing members, anchors and connections shall be designed to withstand local positive and negative wind pressure loads in accordance with requirements of the Authority having Jurisdiction. The velocity pressure shall be based on a probability of being exceeded in any 1 year in 10. The values of C_p shall be taken from the supplement to the National Building Code of Canada. The values of C_{pi} shall be taken as -0.3 or $+0.0$ except for the floors with opening doors where $+0.7$ or -0.7 shall be used, whichever is least favourable or as recommended by the Departmental Representative, whichever values are higher.
- .6 Design of curtain wall framing members, anchors and connections shall be designed for earthquake forces in accordance with the Authority having Jurisdiction.

The curtain wall system shall be designed to limit deflection orthogonal to the plane of the glass under wind or guard loads to $L/175$ in all clear span dimensions of glass and framing members. The maximum deflection of any member in a direction parallel to the plane of the wall, when carrying its full design direction load, shall not exceed 75% of the design clearance dimension between that member and the top of glass or any part immediately below it. Such loads shall take into account the full scope and/or range of all related performance requirements including, but not necessarily limited to, the ambient temperature range of -18°C to $+40^{\circ}\text{C}$, the resultant thermal movement, the heat absorption characteristics of the metal framing members and panels and other applicable components and related building tolerances.
- .7 The connection of the curtain wall to the structure of the building shall be detailed in such a way that only horizontal and vertical forces are transmitted. No bending moments shall be applied by the curtain wall to edges of the slabs.

- .8 Anchorage shall be designed to accommodate all thermal, seismic and building movements without any harmful effect to the curtain wall including glass and glazing and sealant applications.
- .9 The curtain wall system shall be designed, assembled and secured to the structure to accommodate the building structure dead and live load deflections. Allow for differential structural deflection of floors of 19 mm. Allow for differential horizontal deflection between floors of 12.7 mm for wind with full performance of the system and 76 mm with no loss of glass for the design earthquake.
- .10 The curtain wall system shall accommodate expansion and contraction of component materials over an exterior air temperature range of -18°C to +40°C and a possible solar heating range to 70°C, and an interior temperature range of +10°C to +30°C without causing; distortion of aluminium members, pinching or distortion or breakage of glass, failure of joint seals necessary for air and watertightness of the system, failure of perimeter seals at interfaces to adjacent wall systems, overstressing of fasteners, or other harmful effects.
- .11 The curtain wall system shall withstand permanent deformation, weld or fastener failure, component disengagement or breakage under loading equal to 1.5 times the design loads.
- .12 Curtain wall shall be designed, assembled and secured to the building structure in a manner that will keep any stresses on sealants within manufacturer's recommended maximum.
- .13 The design, installation and performance of the curtain wall, including the glass and all related components, shall accommodate the fabrication and installation tolerances of all related work not included in this section without the loss of, or any detrimental effect to, the performance requirements herein specified. This requirement is in addition to the anticipated building structure movements and deflections.
- .14 Design of aluminum framing members shall be as per CAN3-S157-M, "Strength Design in Aluminum" and, where applicable, CAN/CSA-S16.1-M, "Steel Structures for Buildings".
- .15 Movement of joints due to structural and thermal modes shall be accommodated without loss of air tightness.
- .16 The curtain wall system shall be fabricated and installed square, level and plumb to AAMA standards. The following erection tolerances shall apply:
 - .1 Maximum variation from plumb: 12 mm/30 m (1/2 inch/100 feet), whichever is less.
 - .2 Maximum alignment of two adjoining members abutting in plane: 0.8 mm (1/32 inch).
 - .3 Maximum sealant space between curtain wall and adjacent construction: 13 mm (1/2 inch).

- .17 The glazing system shall be installed so that it forms a continuous unbroken air seal on the room side of the assembly. The air seal shall extend from the glazing assembly to adjoining wall components at all interfaces. Air tightness of the curtain wall system and interfaces shall restrict infiltration and exfiltration of air through the system to 0.1 L/s/m^2 when tested in accordance with ASTM standard E283 at a pressure differential of 300 Pa.
- .18 Watertightness of the glazing system shall prevent water appearing on the inside finished surfaces of the glazing system when tested in accordance with ASTM standard E331 at a pressure differential of 700Pa.
- .19 The curtain wall system overall (glass and frame, using standard frame) sizes thermal transmission coefficient shall be calculated according to CSA A440.2 using a recognized computer analysis program such as by Windows 4/1 by Lawrence Berkeley Lab as follows:
 - .1 The overall “U” value (frame and glass) to be not more than $2.0 \text{ W/m}^2\text{K}$ ($0.35 \text{ BTU/hr.ft}^2\text{F}$).
 - .2 The centre of glass U value shall be not more than $0.30 \text{ W/m}^2\text{K}$ ($0.05 \text{ BTU/hr.ft}^2\text{F}$).
- .20 The shading coefficient (SC) and visible light transmission (VLT) shall be calculated according to CSA A440.2 using a recognized computer analysis program. Shading coefficient for the project to be between 0.62-0.68. VLT for the project to be 0.72-0.76.
- .21 The curtain wall Condensation Index (I) shall be tested according to CSA A440. Minimum I for the project to be not less than 60. .
- .22 The curtain wall Sound Transmission Coefficient (STC) shall be tested in accordance with ASTM E90. Minimum STC for the project shall be not less than 25 db.
- .23 The insulating glass units shall have true and parallel faces prior to installation of units on site.
- .24 Clearances used for glazing shall be selected with due regard for the manufacturing and erection tolerances of the curtain wall and its components as well as effects of racking due to vertical and horizontal deflections and temperature effects.
- .25 All fastenings and fixings shall be concealed.
- .26 Labels and trademarks, including applied labels, shall not be visible on the finished work, except identification of safety glass as required by code.
- .27 All movements of curtain wall to be noiseless.
- .28 Design system to support weight of future shades/blinds. Allow weight of 4.00 kg per metre horizontally for shades/blinds.

.29 Structural Silicone Design:

- .1 Carry out design of structural silicone joints by rational analysis including all movements specified herein. Maximum stress shall not exceed 138 kPa (20 psi) in tension or shear for short term loading. Maximum stress in shear for long term loading due to the dead load of glass shall not exceed 7 kPa (1 psi) or the limit imposed by sealant manufacturer, whichever is less.
- .2 The joint shall be essentially rectangular in shape and shall include no internal corners which could precipitate tearing or create high local stresses.

1.5 SUBMITTALS

- .1 Submittals to be made in accordance with Section 01 30 00 – Submittals.
- .2 No work shall be fabricated until the shop drawings, structural calculations and all other related submittals, documentation, certifications, samples and test report have been reviewed by the Departmental Representative, unless otherwise directed by the Departmental Representative in order to reduce the fabrication period.
- .3 Design Proposals/Submission after Tender Close:
 - .1 Submit for the Departmental Representative's review, a design proposal of the curtain wall and glazing system being provided, in accordance with the design and performance requirements specified herein.

The design proposal shall include full size details of the curtain wall, doors, operators and entry system. The proposed designs shall include plan and vertical sections through typical horizontal and vertical members; plan and vertical sections through curtainwall sill at typical floor; partial elevation of various typical wall areas and corner details. Include also typical sections and details of anchorage details, proposed glass and glazing method and aluminum finish.

The Departmental Representative recognizes that custom glazing systems may not have testing certificates at the time of bidding, however the act of submitting a bid implies that the system being proposed by the contractor will meet the performance specifications of this section.
 - .2 Submit also with the design proposal a copy of the documented stress analysis for glass.
 - .3 Submit a complete listing of products, manufacturers, suppliers and fabricators for the principal components of the curtain wall, doors, operators, hardware and glazing system to the Departmental Representative for review. Standard catalogues of brochures are not an acceptable substitute for drawings.
 - .4 Any technical information contained in the design proposal will be treated as strictly confidential.
 - .5 The Departmental Representative's review of these design proposals will not relieve this contractor from any of the responsibilities stated above or any other responsibilities or requirements herein specified.

- .4 Shop Drawings:
- .1 Submit shop drawings for the curtain wall system complete with a seal of a Professional Engineer registered to practice in B.C. certifying that the works of this Section meet or exceed the wind, guard, seismic and snow loading requirements of the B.C. Building Code. Indicate design loads on all submitted shop drawings.
 - .2 Shop drawings shall incorporate plans, elevations, sections and full size details for all work included in this section. The details shall show:
 - .1 frame sections, glazing unit to frame connection, anchorage assemblies, integrations to existing and retrofit wall components at the perimeter of the work;
 - .2 metal, gasket, glass, and accessory material type, thickness and finishes. The type, size, and thickness employed in manufacture of the glass units, minimum frame lap or edge of glass restraint shall be shown on the shop drawings;
 - .3 line of the air seal, both internal to the system and at the point of continuity with the surrounding air barrier system. All joinery on the line of the air seal must be gasketed or sealed with a properly designed sealant joint and accommodate all structural and thermal movement.
 - .4 areas to be sealed and sealant type;
 - .5 all attachment points, schedule of anchorage assemblies (fasteners, connectors, anchors, washers, accessory items and welds), and layout of all anchorage assemblies. Indicate all forces applied to the connection to the structure.
 - .6 type, size, spacing of welds.
 - .7 direction and magnitude of expected thermal movements, and method at locations where thermal expansion and contraction are accommodated;
 - .8 fabrication and erection tolerances;
 - .9 schedule of all glazing accessory parts, gaskets, fasteners, and sealants, including designation of locations to be used and including specification sheets where applicable.

- .5 In addition to the shop drawing submission requirements, provide the following information:
 - .1 Letters of Assurance: The Registered Professional Engineer who signed and sealed the shop drawings shall perform sufficient field reviews in order to provide a letter of professional assurance after completion of the Work, giving assurance that the Work has been fabricated and installed in general conformance with the sealed shop drawings. Approved forms are BC Building Code Letters of Assurance (Schedule C). Written inspection reports of field reviews shall be submitted promptly as the field reviews are made.
 - .2 Structural calculations certified by a Registered Professional Engineer, that the various curtain wall framing members and anchorage will withstand the various conditions as required by the performance requirements specified herein. The structural calculations shall include, but not be limited to:
 - .1 Engineering calculations to show that maximum deflection does not exceed design criteria under full design load.
 - .2 Structural calculations for frames, connections, back-up panels and glass. Include analysis for wind and seismic loads, dead load and window washer load on curtain wall framing members anchors horizontal guard rail loading and anchor inserts.
 - .3 Thermal stress calculations for glass.
 - .4 Thermal movement calculations for frames.
 - .5 Computations for the justification of all assembly elements and/or sections.
 - .6 Cross reference calculations to the applicable shop drawing details.
 - .3 Re-confirm and submit the bar chart information submitted at tender submission.
 - .4 The applicable glass manufacturers shall submit with the shop drawings, written certification for the Departmental Representative's review stating that all glass and glazing materials and requirements as detailed and specified on the shop drawings (designating the shop drawings reviewed by enumerating sheet number, dates and revisions) have been reviewed and approved for use relative to their specific application(s), dimensional design and profile parameters, and conformance to all requirements as detailed and as specified in the drawings and specifications.
 - .5 Written certification of S.T.C. ratings complete with full performance analysis.
- .6 Samples:
 - .1 Submit duplicate colour samples of aluminum finish to the Departmental Representative for final selection and approval of colour.

- .2 Submit with the shop drawings a sample of the various component sections of the complete curtain wall, clearly identified as to their location and finished as specified.
- .7 Maintenance Manuals: Submit to the Departmental Representative four (4) copies of recommended cleaning procedures, with the O&M Manual noted in 01 78 23 – Maintenance and Renewal Manual for the curtain wall, including materials and methods to be used which will not stain or harm the aluminum components, including glass, sealants and glazing materials and methods to be used which will not stain or harm the aluminum components, including glass, sealants and glazing materials, in any manner whatsoever, in accordance with Section 01 30 00. All cleaning requirements and/or recommendations during and after erection shall be coordinated with the Contractor.
- .8 As-Built Shop Drawings: Submit a minimum of four (4) complete sets of “As-Built” shop drawings for the Departmental Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Handle work of this section in accordance with AAMA CW-10.
- .2 Be responsible for the protection of the complete curtain wall system during fabrication, shipping, storage and erection. Work which is scratched, bent, broken or otherwise damaged, shall be replaced by this contractor prior to erection, to the satisfaction of the Departmental Representative at no cost to the Departmental Representative.
- .3 Be responsible for the proper scheduling of delivery and erection of the curtain wall components, all in accordance with the construction schedule.
- .4 All materials delivered shall match the approved samples in all respects. Packaged materials shall be delivered in the original unopened labelled containers of the approved manufacturers. Components shall be protected against soiling and damage during shipment and storage. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- .5 Erect and maintain adequate barricades, warning lights and signs to safeguard traffic, the public, tradesmen and others beneath and in the immediate area of glass and material hoisting and handling operations.

1.7 WARRANTY

- .1 The curtain wall frames and integral seals shall be designed to have an expected service life of 30 years. All seals, gaskets, corrosion protection, coatings, and attachments are expected to be serviceable at the end of this service period.
- .2 The complete curtain wall system contractor shall represent and warrant to the Departmental Representative that the work included in this section will be free of defects and deficiencies which appear during a period of five (5) years from certified date of Substantial Performance of the Project.

- .3 The curtain wall system contractor agrees to correct promptly at its own expense all defects and deficiencies in the work included in this section. In all cases, defective or deficient work shall be removed and replaced with work acceptable to the Departmental Representative, at no additional cost to the Departmental Representative and at such times as the Departmental Representative may designate.
- .4 For the purposes of this clause but without limiting the generality of this clause; defects or deficiencies shall include:
 - .1 Defects or deficiencies in design, workmanship or materials forming part of the work of this section.
 - .2 Any failure of the work of this section to remain a weathertight and watertight installation or to fully comply with the performance and quality requirements of this section.
 - .3 Any failure of the faces of the curtain wall to remain straight, true and plumb in every respect, provided that a tolerance will be permitted as specified.
 - .4 Air leakage greater than that specified.
 - .5 With respect to aluminum materials, excessive non-uniformity, pitting or corrosion of aluminum, including any non-uniform fading during the warranty period to the extent that adjacent panels have a gloss and/or colour range greater than originally accepted glass and/or colour range samples as approved by the Departmental Representative and any pitting or other type of corrosion discernible from at 10'-0" distance resulting from natural elements in local atmosphere.
 - .6 With respect to sealant materials, any defects or deficiencies in sealants resulting in adhesive, cohesive or shear failure of joints, staining of surfaces adjacent to joints by sealant or primer by migration through building materials and contact with them and chalking or visible colour change on the surface of cured sealed materials.
 - .7 With respect to sealed glazing units, hermetic seal failure, fogging, reflective coating defects, low emissivity coating defects, breakdown due to edge flaws (chips, gouges, etc.) migration of edge spacers and breakage due to thermal stress.
 - .8 With respect to frit/scrim defects and breakage due to edge flaws (chips, gouges, etc).
 - .9 "Materials" shall include glass and glazing, aluminum, gaskets, tapes and sealants.
- .5 On or before the certified date of Substantial Performance of the Project, this contractor shall obtain and deliver to the Departmental Representative written warranties or guarantees, in the name of the Departmental Representative, from manufacturers of materials against defects or deficiencies of the type described in this clause.

1.8 **MOCK-UP**

- .1 Construct mock-ups in accordance with Section 01 33 00 - Submittals.
- .2 Assemble and set up on-site a curtain wall mock-up assembly. The mock-ups shall be comprised each of the actual systems used incorporating as a minimum (1) one typical vertical storey including floor and ceiling slabs above and below, by a minimum of 20'-0" wide including portion of non-window wall assembly adjacent to curtain wall, SSG glazing and capped mullions. Co-ordinate with trades of adjacent sections as required. The mock-ups are to be complete in every respect to the final product; this shall include but not be limited to the following:
 - .1 types of horizontal and vertical curtain wall mullions
 - .2 expansion joints
 - .3 fixed and opening vent framing glazing units
 - .4 glazing installation
 - .5 adjacent cladding system
 - .6 anchors, gaskets, attachments
 - .7 membrane seal systems and water deflector
 - .8 caulking and sealants
 - .9 firestopping
 - .10 trim, flashings, reveals
 - .11 metal panels
 - .12 and all other materials required to replicate the actual installation

The members and materials shall be identical to those shown on approved samples and on the reviewed shop drawings, as specified herein. All conditions of support shall be simulated as accurately as possible.
- .3 Construct mock-ups where directed.
- .4 Allow sufficient time for mock-ups and site testing, evaluation alterations and adjusting as required so as not to interrupt the construction progress schedule of the project.
- .5 Allow 24 hours for review of mock-up by Departmental Representative.
- .6 Modify and alter mock-ups as necessary to obtain required approvals.
- .7 Upon successful completion of sample mock-up panels, the completed mock-up may become part of finished work unless major changes which affect the aesthetics of the unit are required to pass the performance requirements.
- .8 Final approved site mock-ups shall serve as standard of quality and workmanship for Departmental Representatives/third party field quality control inspections of all subsequent work to match approved sample installation.

1.9 PRE-INSTALLATION MEETING

- .1 Convene one week before starting work of this section.

1.10 QUALITY ASSURANCE

- .1 Work of this section shall be performed by trade specialists having a minimum of five (5) consecutive years of successful completion of work similar in scope and nature.
- .2 This contractor shall be prepared to prove to the Departmental Representative's satisfaction, that they have adequate facilities and skilled personnel suitable for the design, detailing, fabricating and installation of the curtain wall assembly.
- .3 Sealants used for the aluminum work shall be selected from those specified and shall be coordinated with the sealant being used by other sections in contact with aluminum and curtain wall work. Preferably, one sealant of the same manufacturer shall be used throughout. If different sealants are selected from those specified, it is the responsibility of the respective Contractors to ensure compatibility between selected sealants, substrates and sealants of other sections, which come in contact with the selected sealant.
- .4 Site Performance Testing:
 - .1 Performance testing is to be conducted by a testing agency designated by the Contractor. The Contractor is to engage a testing agency experienced in the work, and preferably located within 2 hours of the project site.
 - .2 All costs to be addressed by the Contractor.
 - .3 Contractor to provide full wall assembly and seals to opening in area of all tests. Test area to include all typical curtain wall conditions.
 - .4 Testing shall include:
 - .1 Water Penetration: Field testing to be in accordance with ASTM E1105-00, by using AAMA 502-02 Test Method B
 - .2 Test levels as noted under performance requirements.
 - .5 In the event that assemblies fail to pass the performance requirements initially, the costs to repair/replace/adjust the assemblies and the costs for subsequent testing to confirm conformance shall be borne by the Contractor.
 - .6 Ensure that all modifications required to pass field test are performed on all other affected or similar windows.

Part 2 Products

2.1 MANUFACTURERS

- 1. Approved Manufacturers: Manufacturers shall develop materials and products of this section to achieve the design intent as specified and as indicated on the drawings.

2.2 MATERIALS

1. General: Thickness, gauges, alloys and tempers of aluminum steel and stainless steel shall be as required for forming and finishing operations and to meet design criteria and performance requirements specified.
2. Aluminum Extrusions: Shapes as indicated and as required to fulfill performance requirements of suitable alloy and proper temper for extruding and fabricating with adequate structural characteristics to meet design and performance requirements specified, and suitable for finishing as specified. The aluminum alloy to be used for aluminum framing shall meet BC Building Code requirements for fire resistance.
3. Pressure plates: All sections with caps must incorporate a full width 19mm pressure plate system. One piece fixed cap systems are not acceptable.
4. Slip Mullions: Fourway joints in the split mullion curtain wall system to have splice plate with mechanically compressed gasket water seals and sealant cap bead.
5. Aluminum Sheet: Supply and install flat sheet aluminum 1/8" (3 mm) thick to profiles, shapes and extent as noted, shown and detailed. Finish to be as specified under finishes clause.
6. The front face of sheet aluminum cladding shall be distortion free and completely free of oil canning under design loads and temperature variations specified. Provide additional angle and Tee stiffeners to back of flat sheet aluminum as required and necessary. Angle stiffeners to be minimum 1-1/2" x 1-1/2" with similar size Tee members. Adhere and fix stiffeners to flat sheet material using adhesives such as Scotch-Grip Plastic Adhesive #1099 by 3M Adhesive. Follow adhesive manufacturer's written specifications and recommendations for installation and application techniques.
7. Thermal Separators: Polyvinylchloride, 50 Shore A durometer hardness plus or minus 5, or Polyamide with glass fibre reinforcing, minimum U value – 0.20 BTU/hour ft² oF.
8. Shims: Stainless steel sheet or rigid PVC.
9. Screws, Bolts, Fasteners: 300 Series stainless steel; sliding connections to be supplied with nylon pads, outside of the line of the air seal.
10. Dissimilar Materials: Separate with bituminous paint, nylon or pre-approved dielectric separator.
11. Membrane Stripping Tie-ins to Aluminum Work, Door Framing and Behind Flashing areas: minimum 2.7 mm thick SBS membrane sheet reinforced with non-woven polyester or glass fleece. Stripping to be a minimum 150 mm wide. Approved products are Soprema – Sopraseal 60 F/F or Sopralene Flam Stick by Soprema, 2.5 mm thick, Protectowrap Jiffyseal 140/60, Blueskin TG by Henry Company. Sheet steel 24 gauge galvanized with bituminous coating such as Airbloc 06 by Henry Company is also acceptable.

12. Sheet Metal Air/Vapour Barriers (Back-pans): Galvanized steel, 20-gauge minimum thickness, galvanized to ASTM-A-525 with zinc coating Z275. Back pans reinforced as required to meet performance criteria specified in this section.
13. Fasteners shall be stainless steel screws. Sheet metal air barrier shall face inside of building and shall be set into the shoulder of the head and jamb frame sections and attached to sill section using stainless steel screws.
14. Entire perimeter joint between sheet metal sheet air barrier and frame sections shall be sealed on back with bead of sealant to provide air seal. Back-up panels shall be vented to outside air.
15. Steel Shapes Required to Join or Reinforce Assembly of Aluminum Components: Shall conform to CSA G40.21, Grade 300 W; galvanized or if galvanizing is not compatible with alloy of component parts, shop paint with zinc chromate primer. Galvanize or paint after cutting to size.
16. Miscellaneous Steel (Anchors and Reinforcement): CSA G40.21 Grade 300 W minimum, hot dip galvanized after fabrication.
17. Covers, Closure Strips, Copings, Flashings: as specified in Section 07 62 00 – Metal Flashing and Trim. Aluminum cover strips, closure strips, coping and flashing shall be as required; fabricated from aluminum sheet or extruded shapes of thickness as required to suit installation and provide rigidity and suitable for finish specified.
18. Glass Units: Refer to Section 08 80 00 – Glazing for vision glass units.
19. Gaskets: EPDM, neoprene or silicone rubber of sufficient durometer to create a positive seal and lip pressure. All gaskets to be dense rubber. Outdoor gaskets to be neoprene or silicone; indoor gaskets to be EPDM, neoprene or silicone. Gaskets to conform to ASTM C 864-79. Gaskets to be continuous at corners (vulcanized, or fused corners) and throughout glass perimeter at inboard glass line.
20. The actual profiles and/or design parameters dimensions, lengths and/or locations and the Shore A durometer hardness shall all be as required to meet the specified performance criteria and shall be as recommended, in writing, by the applicable neoprene manufacturer.
21. Glazing splines and air seals: Shall be pressure fitted, extruded neoprene (“dry-dry” seals) with continuous integral locking projections to engage into the metal glass holding member, and be designed to be in contact, at all times, with adjacent elements. Seals to the glass formed by adhesive tape alone will not be accepted. (Tremco’s Vision Strip is acceptable as exterior gasket).
22. Spacer blocks: Shall be neoprene (80 durometer) or non-ferrous metal and designed to be fully bedded in glazing materials, to give minimum 1/8” clearance and as required by glass weights and light sizes.
23. Spacers at glazing pockets: Where single glass, aluminum sheet or membrane is glazed into double-glazing pockets, provide continuous rigid PVC spacers or extruded aluminum infill strips. Polystyrene infill strips will not be accepted.

24. Sealants: as specified in Section 07 92 00, as recommended for substrates.
1. Structural Glazing Silicone conforming to ASTM C-920, Type S, NS, Class 25 and CAN/CGSB 19.13-M87. Type to be GE Silicone; Construction SGS 1200, Ultraglaze SSG-4400 and Ultraglaze SSG-4000 as applicable by location and as recommended by manufacturer of curtain wall system. Use silicone structural sealant at all sealed units to aluminum framing at SSG grid frame. Use silicone weather seal and backer rod at all hermetically seal units joints to each other at all SSG grid framing.
 2. All sealants shall be compatible with adjoining and/or adjacent sealants, back-up materials; substrate materials and their respective finishes. All interior sealants shall be applied in an exacting manner, the same as for the exterior seals.
 3. All sealant applications shall be tooled to a slight, even, smooth concave profile and all exposed sealant applications shall be both taped and tooled.

2.3 ALUMINUM DOORS

1. Standard swing type: triple glazed aluminum doors; shall be installed at locations indicated, as an integral part of the aluminum curtain wall system. Sizes of doors shall be as indicated. Sizes are nominal. Check details for actual sizes. Include also door frames for aluminum doors of extruded sections to match and interface with curtain wall framing system.
2. Approved Types: Kawneer Style 260 Series, Alumicor ThermaWall 2600; or pre-approved equivalent. Door shall be 2" thick, with top rail, bottom rail and styles to manufacturer's standard for door specified.
3. Materials: Sections extruded from 6063-T5 aluminum alloy. Stops to be square snap-in type without exposed screws, exterior stop non-tamperable. Glazing beads to be preformed vinyl or neoprene. Provide adjusting mechanism in top rail for minor clearance after installation.
4. Weather-stripping: Install thermoplastic elastomer tubular weathering on semi-rigid backing at all exterior doors on three sides. At door bottom rails install EPDM blade gasket sweep strip with concealed fasteners.
5. Hardware: The hardware cash allowance is to be based on the following. Final design and selection by the Departmental Representative.
 1. Pivots: Offset pivots top and bottom, each leaf.
 2. Closer: LCN 5030 OP Series, overhead concealed closer with exposed arm, single acting, with hold open. Closer sizes to suit door.
 3. Security Lock: Each door shall have Adams-Rite MS 1850A maximum security lock operated by cylinder from exterior and interior.
 1. Adams-Rite MS 4043 cylinder guard to exterior keyed cylinders.

2. Master keyed cylinders provided under Finish Hardware Section.

6. At exit doors, noted as panic hardware provide manufacturer approved, concealed panic device, with contoured crash bar (exit only) to all exit doors.
7. Push and Pulls: shall be 12” high, 1” diameter, similar to Kawneer Classic Offset, on both sides at door, in satin stainless steel finish.
8. Thresholds: 4½” wide extruded aluminum x width door opening.
9. Power Assisted Door Operators: Dor-o-Matic Mid Swing without “push and go”.
10. All exposed parts of hardware shall be finished to match door and frame sections.
11. Top rail of doors and head members shall be well reinforced to receive and anchor all specified hardware securely in place.

2.4

FINISHES

1. Finish coatings: conform to AAMA standards
2. Interior exposed aluminum surfaces: clear anodized finish in accordance with Aluminum Association AA-M12C22A31, Class II specifications. Coating thickness shall be minimum 0.4 mils.
3. Interior exposed aluminum surfaces: Coating finish equal to Duracron Metallic by PPG Canada Inc., factory applied thermal setting acrylic enamel coating conforming to requirements for acrylic enamel finish specified in AHMA 603 and supplemented as follows:
 1. Colour and gloss: Standard colour as selected by Architect.
 2. Repairable: by use of an interior grade air-drying touch up material available from coating manufacturer and which match special colour used.
4. Exterior exposed aluminum surfaces: clear anodized finish in accordance with Aluminum Association AA-M12C22A41, Class 1 specifications. Coating thickness shall be minimum 0.7 mils.
5. All concealed aluminum and aluminum thresholds may have standard mill finish.
6. All exposed aluminum shall have factory applied removable protective film covering.
7. All exposed parts of hardware shall match adjacent aluminum finish and colour.
8. All stainless steel to be Type 304 having a #4 satin finish.

Part 3 Execution

3.1 FABRICATION

1. All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed references and standards and/or as specified herein. Work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and adjoining building component tolerances and design criteria. All forming, welding and cutting operations shall be done prior to finishing.
2. All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, indentations, waves or flaws of any nature impairing strength or appearance; fitted with proper joints and intersections and with specified finishes. All members shall be extruded unless otherwise indicated on the drawings and shall be securely engaged into adjacent components. Extrusions shall be toleranced to eliminate any edge projection or misalignment at joints.
3. No field forming, cutting and/or alteration of aluminum framing members will be allowed. All framing members will be shop fabricated and finished. No unfinished surfaces will be permitted on exposed surfaces.
4. Expansion Joints: Expansion joints within aluminum framing shall be so designed and constructed to provide noiseless and free movement, and be and remain, permanently watertight.
5. Protection of Metals: Aluminum surfaces to be placed in contact with masonry, concrete, steel supporting members or other dissimilar parts shall, before shipment from the fabricating plant, be given a heavy coat of an alkali resistant bituminous paint. The paint shall be applied, without the addition of any thinner, in strict accordance with the paint manufacturer's instructions. Such paint shall be allowed to dry before assembly of parts.
6. Joints in Metal Work: All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise required, shall be accurately fitted, rigidly secured with hairline contacts and sealed watertight. Where two or more sections of metal are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any pointing materials.
7. Shop Assembly: Insofar as practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily assembled in the shop and marked, before disassembly, to ensure proper assembly later on in the works.
8. Do not bridge thermal barriers with flashings or other conductive materials.
9. Conceal fasteners whenever possible.
10. Welding of Steel to Conform to CSA W59-M84: Welders to be fully approved by the CWB and comply with CSA W47.1-83, Division 3.

11. Welding of Aluminum shall be as per the CSA W47.2-67 qualification code.

3.2 EXAMINATION AND CO-ORDINATION

1. Verify all dimensions and tolerances of supporting structure by field measurement. Surfaces that are considered not acceptable to receive the work of this section must be reported to the general contractor/project manager. The commencement of work shall imply the acceptance of previous construction.
2. Submit written notification to the Departmental Representative and Contractor documenting any and all field dimensions and/or conditions which are at variance with those on the reviewed shop drawings, the contract documents and/or which are detrimental to the proper and timely erection of the complete curtain wall system. The decision regarding corrective measures shall be obtained from the Departmental Representative. The Curtain Wall contractor shall ensure the compatibility of existing and adjacent items in relationship to this work.
3. Co-ordinate the installation of anchors and fixings with the appropriate trade as well as the sealing between work of this section and other sections. The continuity of all air/vapour seals at areas of adjoining trades must be ensured.
4. Co-ordinate the delivery of glass and other materials so as not to interfere with the work of other sections of this specification.
5. Protect work of other trades as necessary from damage resulting from work of this section. Damage caused by this contractor shall be corrected and made good at no expense to the Departmental Representative.
6. Ensure that conditions of temperature, humidity and precipitation are suitable for installation, in accordance with manufacturer's instructions. No glazing shall be installed when framing members and other glazing materials are wet or frosted.

3.3 INSTALLATION

1. All work of this section shall be installed in strict accordance with the reviewed shop drawings, by the erection forces of the fabricator of the curtain wall, and cladding under the direct supervision of the fabricator.
 1. Install all anchor bracket assemblies, anchor brackets, anchor straps, shims, stud bolts, nuts, washers, splice plates, bracing, etc. as required to be attached to and/or built into building frame as required for support of the curtain wall and glazing assemblies.
 2. Provide alignment attachments and shims to permanently fasten system to building structure. Welding shall be done with electrodes and/or by methods recommended by suppliers of metal being welded. Clean weld surfaces; apply pure zinc or zinc chromate primer to field welds and adjacent surfaces.
 3. Anchorage of the curtain wall, doors, and cladding to the structure shall be in strict accordance with reviewed shop drawings.
 4. All vertical members shall be plumb, all horizontal members shall be level; free of warp or twist. Maintain assembly dimensional tolerances.

5. As erection progresses, the members shall be securely connected to take care of all dead loads, wind and erection stresses. Any failure to make proper and adequate provisions for stresses during erection shall be entirely at sole risk and responsibility of this sub-contractor.
6. Accurately fit and frame components carefully to produce continuity of line and design. Provide flush, hairline joints and connections.
7. Provide deflection head framing members for curtain walls, window framing at head, sill and jamb sections as required to meet differential movement and deflection requirements.
8. Provide thermal isolation where components penetrate or disrupt building insulation.
9. Coordinate installation of fire stop insulation, at joints between each floor slab edge and exterior curtain wall assembly. Leave space at top of slabs to allow for installation of smoke seal of required depth. Where bottom of joint will be exposed to view, leave space to allow for installation of sealant by Section 07 92 00. Use minimum two impaling clips per 1.2 m (4'-0") length of firestopping material to support and retain firestopping in place in vertical joints.
10. All glazing shall be carried out in accordance with Departmental Representative reviewed shop drawings. Install glass in accordance with Section 08 81 00 – Glass and Glazing.
11. Coordinate attachment and seal of perimeter air barrier and vapour retarder materials. All connections of the air/vapour/waterproofing barrier membrane to be mechanically attached to the window section and wall assembly.
12. Install all gaskets, tapes and sealants as required to provide watertight, weathertight and airtight joints between mullions, copings and all other metal-to-metal contacts of the complete curtain wall system. Apply sealant in accordance with Section 07 92 00 – Building Envelope Sealants.
13. Furnish and install associated metal panel covers, louvers, closures, flashings and trim in accordance with Section 07 62 00 – Metal Flashing and Trim. Work to conform to profiles shown on the drawings and as required to make the work watertight, weathertight and airtight.
14. Where indicated, incorporate door units in curtain wall system. Supplement as follows:
 1. Provide suitable curtain wall jamb adaptors and accessories to suit entrance door requirements.
 2. Make all cutouts, recesses, mortises required to accommodate hardware; reinforce all cutouts. Door jambs, rails, transom bars and head members shall be well reinforced to receive and anchor all specified hardware securely in place. All hardware shall be installed in strict accordance with manufacturer's instructions and templates. After completion of installation, check and re-adjust all items of hardware.

3. Maximum security deadlock sets shall be prepared to receive correct type of keyed cylinder. All cylinders will be supplied under the finishing hardware section and installed by this contractor.
 4. Coordinate and cooperate with electrical trade and door security system for the supply and installation of electronic “Mag” lock system to be installed by others.
 5. Provide matching continuous (full width of entry door assembly) custom aluminum jamb sections, aluminum header box section and cover plate to suit automatic door operators.
15. Apply all joint packing and sealants to joints in curtain wall, at all penetrations through curtain wall and at joints between curtain wall and adjoining construction. Apply sealant in accordance with Section 07 92 00 – Building Envelope Sealants. Adjacent materials which have been soiled shall be cleaned immediately before the sealant hardens or stains the adjoining surface.

3.4 FIELD QUALITY CONTROL

1. Inspection and testing of installed curtain wall system may be carried out by an inspection and testing firm designated by Departmental Representative.
2. Other than for site assembly mock-up, all costs to be addressed by the Departmental Representative.
3. Testing may be undertaken to ensure that the installed curtain wall system conforms to the specified design criteria.
4. On completion of the building envelope installations, thermographic testing may be done to evaluate the continuity of the wall assemblies and establish possible problem areas such as air leakage or heat loss, which would require further investigation of such potentially defective areas. If, as the result of such further investigation, it is determined that the building envelope does not conform to the requirements of the contract documents, take responsibility for and pay cost of necessary remedial action to correct such defects, including work of other trades affected by the remedial work, and including cost of re-testing to verify acceptability of corrected work.

3.5 TOUCH-UP

1. Where permitted by Departmental Representative, touch-up minor scratches, abrasions and other minor defects in coating finishes.
2. After connecting anchors have been completely attached, prime paint exposed surfaces of anchor embeds and touch up all welds and damaged surfaces of anchors with prime paint.

3.6 ADJUSTING

1. Remove and replace improperly installed units and damaged units not acceptable to the Departmental Representative.

3.7 CLEANING

1. Immediately clean off all smear marks, excess sealant, etc. caused during erection of the curtain wall assembly.
2. Upon completion of the work of this section, remove protective coverings and paper labels from exposed surfaces.
3. Co-ordinate final interior and exterior cleaning of the curtain wall system and glass included in this section.
4. Clean surfaces of all smears, marks and discoloration. Cleaning shall be in accordance with applicable provisions of listed standards and the requirements of the aluminum manufacturer. All cleaning materials shall be acceptable to the applicable aluminum and glass manufacturers; where doubt exists, make spot tests.

3.8 PROTECTION

1. Protect finished work from damage/staining during and after installation.

END OF SECTION

Part 1 General

1.1 REQUIREMENTS INCLUDED

- .1 Furnish all labour, materials, equipment and services necessary for complete design, fabrication, supply and installation of aluminum skylights as indicated on the drawings and as specified.
- .2 The work of this section shall include, but shall not necessarily be limited to the design, fabrication, supply and installation of the following:
 - .1 Self-supported glazed aluminum skylights, including aluminum glazing bars, glazing caps and all glass and glazing.
 - .2 All structural sealants, weathering sealants, gaskets, setting blocks, baffles, membrane, etc. required for all glazing and weathertight and waterproof construction of the skylight.
 - .3 All anchors, connections, screws, bolts, etc. required for attachment of skylight to building structure and structural steel support framing.
 - .4 All aluminum flashings, closures, covers, ridge cap, and the like required in connection with the skylight.
 - .5 All necessary reinforcing members, brackets, anchors, screws, bolts, etc. to ensure a first class installation and to ensure skylight complies with specified performance criteria.
 - .6 Sealant between various components comprising the skylight and between skylight and adjoining construction.
 - .7 Rigid insulation within skylight system as indicated.
 - .8 Include also the checking of lines and levels of structure as required for the proper layout and installation of the skylight.
 - .9 Provide all scaffolding, hoisting and safety facilities required for installation of skylight.

1.2 PERFORMANCE DOCUMENTS

- .1 This is a performance specification and is issued in conjunction with the drawings which indicate the general arrangement of the work, the dimension, the structural steel framing support and the major architectural elements of construction. As performance documents, the drawings and specifications do not necessarily indicate or describe all items required for the full performance and completion of the work of this section.
- .2 The term “glazing bar” where used in this section means rafters and purlins, comprising the skylight glazing framing.

1.3 QUALITY ASSURANCE

- .1 The firm producing and executing the work of this section shall have minimum of five (5) years experience in the manufacture and erection of work of similar scope and nature to that specified.
- .2 The work of this section shall be installed, glazed and adjusted by experienced workmen in accordance with manufacturer's written instructions and the reviewed shop drawings.

1.4 REFERENCED STANDARDS

- .1 The applicable current and/or latest editions of references and standards as published by the following organizations or agencies, designated by abbreviations in this section, are all to be considered as part of this section. The aluminum skylight and related work shall conform to the applicable requirements of these references and standards unless indicated or specified otherwise or as modified by governing codes.
 - .1 British Columbia Building Code
 - .2 National Building Code
 - .3 AAMA - Architectural Aluminum Manufacturers Association
 - .4 ASTM - American Society for Testing and Materials
 - .5 CGSB - Canadian Government Specifications Board
 - .6 CSA - Canadian Standards Association
 - .7 NAAMM - National Association of Architectural Metal Manufacturers

1.5 DESIGN RESPONSIBILITY

- .1 The design, fabrication and erection of the aluminum framed skylight as required to meet these performance specifications shall be the complete responsibility of the Contractor. Because of this design responsibility the final reviewed shop drawings shall form part of the contract documents.
- .2 The design intent of the skylight as indicated is to provide a self-supporting skylight system, which incorporates flat double glazed sealed units retained on all four (4) sides by aluminum glazing caps.
- .3 The details shown are indicated for the purpose of indicating the preferred profiles and dimensions necessary to achieve the design intent and are not intended to eliminate other design proposals. Minor dimension and profile adjustments to that shown may be made in the proposed design in the interest of fabrication or erection methods or techniques, the weatherability factor, or the ability of the design to satisfy the design and performance requirements specified, provided that the design intent and the intent of the specifications are maintained.

- .4 The method of assembly and anchorage of the aluminum glazing gars (framing) is schematic and shows general intent only. Location and methods of providing same shall be the Contractor's responsibility, who shall design the assembly, reinforcing and anchorage to suit each specific condition in an acceptable manner complying with the design and requirements specified herein.
- .5 The Departmental Representative's review of any and all items designated in this specification will be done with the understanding and assurance that the Contractor is fully responsible for the performance of all work covered in this section.

1.6 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 The intent of this specification is the provision of a manufacturer's standard skylight system which has been previously tested to conform to the performance requirements specified and also conforms with the other design and performance criteria.
- .2 Design, fabricate and install component parts of the skylight to meet or exceed the following criteria. The dimensions which must be maintained in the design are as follows:
 - .1 The centre to centre spacing of aluminum glazing bars, as indicated.
 - .2 The shape, width and depth of the aluminum glazing bars and glazing caps.
- .3 Design skylight to support dead load plus live loads in accordance with requirements of the BCBC, and taking into account snow accumulation and unbalanced loadings as well as wind and interior pressures with maximum deflection of any member not to exceed 1/175 under positive or negative design live loads. Reference velocity pressure shall be 1 in 10 in accordance with requirements of the British Columbia Building Code.
- .4 The skylight shall be designed and installed to meet requirements of the British Columbia Building Code, including seismic restraint requirements.
- .5 Structural performance shall be based on CSA standard CAN3-S157 "Strength Design in Aluminum" and a maximum deflection of 1/175 of the span.
- .6 Air infiltration and exfiltration shall not exceed 0.06 cfm/ft² when tested in accordance with ASTM E283-84 at a pressure differential of 10.4 psf.
- .7 There shall be no water infiltration when tested in accordance with ASTM E331 with a pressure differential of 25 psf.
- .8 Condensation resistance temperature index of the framing shall be a minimum of 59.8.

- .9 The skylight shall be designed to provide for thermal movements of components without overstressing the materials, failure of joint and glazing seal or other detrimental effects caused by an ambient temperature range of -18°C to +60°C.
- .10 Welding design and workmanship shall be applicable standards including the relevant parts of CSA S244.
- .11 Glass thickness shall be designed to withstand local positive and negative wind loads and snow loading in accordance with the BCBC.
- .12 Glass shall be designed in conformance with CAN/CGSB-12.20-M89 “Structural Design of Glass for Buildings”.
- .13 Thermally, the framing members shall have a resistance to heat transfer equal to or better than that of the area along the bottom of the sealed glass units.
- .14 Aluminum framing of skylight shall incorporate a pressure equalized rainscreen system with a complete air and vapour seal, allowing any water entering the framing to drain to the exterior and also allow air into the pressuring chamber to provide instantaneous pressure equalization. Vents and drain holes shall be inconspicuously located and in such positions as not to contribute to staining, streaking or marking of the glass, or glazing bars.
- .15 Skylight design shall allow for expansion and building movements with a fixing method which cannot work loose, incorporating an inert, low friction separator between moving metal parts. Skylight design shall compensate for skylight expansion and contraction.
- .16 Design and anchor skylight to the structure to accommodate the building structure dead and live load deflections. Design for deflections indicated on structural drawings.
- .17 Clearances used for glazing shall be selected with due regard for the manufacturing and erection tolerances of the skylight components as well as effects of racking due to vertical and horizontal deflections and temperature effects.
- .18 Dissimilar metals shall be separated by an inert material. Separator between aluminum and steel framing members shall be PVC to manufacturer’s standard.
- .19 Exterior pressure caps shall provide a uniform clamping load on the glass not exceeding 178 kg/m. The caps shall be fixed with cap screws of minimum 1/4" diameter incorporating a sealing washer, at centres to provide adequate clamping loads and to resist wind suction. Cap screws shall be concealed by a continuous snap-on cover.
- .20 All anchor assemblies and components and reinforcements, including all related connections and/or fasteners, for and related to the skylight shall be designed, furnished and installed as required for full compliance with the specified performance criteria.

- .21 All materials, recommendations and details describing the proposed use, design and application procedures for all anchorage shall be documented and fully described on the shop drawings.
- .22 The compatibility with other materials and sequence of installation for all sealants shall be carefully considered in the design in order to ensure the required care and optimum performance. Sealants shall not degrade and/or fail under any design conditions including, but not limited to, thermal movement, standing water, ultra-violet exposure and/or other adverse environmental conditions.

1.7 SUBMITTALS

- .1 Shop Drawings: Submit shop drawings for the skylight to the Departmental Representative for review.
 - .1 Shop drawings shall incorporate plans, elevations, sections and details for all work of this section. The details shall show and specify all metal and glass thicknesses, types and finishes; areas to be sealed and sealant materials; gaskets; direction and magnitude of thermal expansion; type of construction including joinery, fasteners and welds; all anchorage assemblies and components; the fabrication and erection tolerances for the work in this section and the layout of all anchors. Include all tie-ins to adjoining systems.
 - .2 Submit shop drawings in accordance with Section 01 33 00. All dimensions shall be verified at site before fabrication.
 - .3 Shop drawings and calculations shall be prepared under the supervision of a Professional Engineer registered in British Columbia. This Engineer shall verify by sealing the shop drawings, that the drawings were prepared under his supervision and that the skylight system meets the specified design and performance requirements and the drawings.
 - .4 Submit also with the shop drawings satisfactory test reports from approved independent testing laboratories certifying that representative skylight details have been tested for compliance with following standards as specified under Clauses 1.6.6 and 1.6.7 herein:
 - .1 ASTM E283 for air infiltration and exfiltration
 - .2 ASTM E331 for water infiltration
 - .5 No work shall be fabricated until the shop drawings and all other related submittals, documentation, certifications, samples, etc. have been reviewed by the Departmental Representative.

- .2 Letters of Assurance: The Registered Professional Engineer who signed and sealed the shop drawings shall perform sufficient field reviews in order to provide a letter of professional assurance after completion of the Work, giving assurance that the Work has been fabricated and installed in general conformance with the sealed shop drawings. Approved forms are BC Building Code Letters of Assurance (Schedule C). Written inspection reports of field reviews shall be submitted promptly as the field reviews are made.
- .3 Manuals: Submit to the Departmental Representative four (4) copies of detailed procedures for the periodic inspections, maintenance and cleaning of all applicable elements of the skylight including glass and finishes, at Substantial Performance of the Project. The above submissions are to be included with the O&M Manual noted in 01 78 23 – Maintenance and Renewal Manual.
- .4 Samples: Submit duplicate samples, upon request, of aluminum finish and all glass and sealant specified to the Departmental Representative for approval. Submit duplication colour samples for aluminum to the Departmental Representative.

1.8 JOB CONDITIONS

- .1 Coordinate and verify by measurement at the site, all dimensions affecting the work of this section. Submit written notification to the Construction Manager documenting any and all conditions which are at variance with those on the reviewed shop drawings, the contract documents and/or which are detrimental to the proper and timely erection of the skylight. The decision regarding corrective measures shall be obtained from the Construction Manager. Ensure the compatibility of existing and adjacent items in relationship to this work.
- .2 Starting work shall imply acceptance of existing conditions and surfaces.

1.9 STORAGE, HANDLING AND DELIVERY

- .1 Be responsible for the protection of the aluminum framing during fabrication, shipping, storage and erection. Replace work which is scratched, bent, broken or otherwise damaged, prior to erection, to the satisfaction of the Departmental Representative at no cost to the Departmental Representative.
- .2 Be responsible for the proper scheduling of delivery and erection of the components, all in accordance with the construction schedule.
- .3 All materials delivered shall match the approved samples in all respects. Packaged materials shall be delivered in the original unopened label containers of the approved manufacturers. Components shall be protected against soiling and damage during shipment and storage.

1.10 GUARANTEE

- .1 The work included in this section shall be fully guaranteed by written certification for a period of ten (10) years from date of Substantial Performance of the Project against any defects in design, materials and workmanship and that it shall remain a weathertight and watertight installation and that any defects will be made good at no additional cost to the Contract. This guarantee shall also include all glass, glazing, gaskets, tapes and sealants.
- .2 In addition, two guarantees shall include the following:
 - .1 Aluminum: Guarantee against the following:
 - .1 Excessive Non-Uniformity: Any non-uniform fading during guarantee period.
 - .2 Pitting or Corrosion: No pitting or other type of corrosion resulting from natural elements in local atmosphere.
 - .2 Sealant: Guarantee against the following:
 - .1 Adhesive, cohesive or shear failure of joints.
 - .2 Staining of surfaces adjacent to joints by sealant or primer by migration through building materials in contact with them.
 - .3 Chalking or visible colour change on surface of the cured sealant materials.
- .3 Glass: Insulating sealed double glazing units shall also be guaranteed for a period of ten (10) years from Substantial Performance of the Project against material obstruction of vision as a result of hermetic seal failure, dust or film formation on the inner glass surfaces. Replace any units failing to comply with this guarantee without cost to the Departmental Representative.
- .4 Defective work shall be removed and replaced with acceptable work at no cost to the Departmental Representative, and at such times as designated by the Departmental Representative.

Part 2 Products

2.1 MATERIALS

1. General: Thicknesses, alloys and tempers of aluminum, shall be as required for forming and finishing operations and to meet structural performance requirements specified.
2. Standard of Acceptance for sloped skylights: Shall be Kawneer 2000 series or approved equivalent.
3. Standard of Acceptance for flat roof skylights: Shall be Columbia Glazing Acrylic Dome or approved equivalent.

4. Aluminum Extrusions: Shapes as indicated and as required to fulfill performance requirements of suitable alloy and proper temper for extruding and fabricating with adequate structural characteristics to meet design and performance specified, and suitable for finishing as specified.
5. Aluminum Sheet: Shall be qualified suitable for finish specified.
6. Fasteners: Exposed fasteners shall be stainless steel (300 Series) or aluminum (6000 Series). Concealed fasteners shall be cadmium or zinc plated to ASTM A165-5 and A164.55.
7. Thermal Separators: Polyvinylchloride, 60 Shore A durometer hardness plus or minus 5.
8. Aluminum Members Required to Join or Reinforce Assembly of Aluminum Components: Alloys recommended by manufacturer or fabricator to develop required strength of assembly.
9. Steel Shapes for Anchorage: Shall conform to CAN3-G40.21-M81.
10. Closure Strips, Flashings and Ridge Cap: Aluminum cover strips, closure strips, flashings and ridge cap shall be as required as detailed; fabricated from aluminum sheet of thickness as required to suit installation and provide rigidity.
11. Insulation: Shall be rigid or semi-rigid glass fibre insulation.
12. Glass:
 - .1 All glass, related glazing materials and requirements shall be verified and coordinated with the applicable glass manufacturers. The type, size, thickness and design including all applicable dimensions, minimum panel edge clearance and minimum frame lap or panel coverage/grippage, shall be verified and documented by the glass manufacturer.
 - .2 The thickness of glass shall be required to meet the specified design and performance criteria.
 - .3 Skylight Glass: Shall be Low E insulating sealed units as follows:
 - .1 Exterior Light: Fully tempered float glass
 - .2 1/2" argon filled space
 - .3 Low E coating on No. 2 surface
 - .4 Interior Light: Laminated glass using two (2) sheets of clear float glass with minimum 0.76mm (0.030") thick clear vinyl interlayer.
 - .4 Insulating sealed units shall conform to the following specifications:
 - .1 To CAN/CGSB-12.8-M90 unbanded hermetically sealed insulating glass assembly.
 - .2 Primary Glazing Seal: Polyisobutylene.

- .3 Secondary Glazing Seal (Edge Seal): Multi-component, chemical curing sealant compound to CAN/CGSB-19.24-M90 Type 2, Class A.
- .4 Window Overall U Value: Not greater than 2.0W/m²K
- .5 Glazing Shading Coefficient: 0.62 - 0.68
- .6 Deflection of Insulating Glass Units: 12mm maximum under service loads.
- .5 Insulating Glass Units: To conform to the Insulating Glass Manufacturers Association of Canada (IGMAC); the manufacturer shall be a member of IGMAC and CAN2-12.8-M76. Fabricated units to meet requirements of CAN2-12.8-M76 with separate lights of glass with a metal spacer filled with a noncorrosive, nongas-absorbing desiccant. Corners of the metal spacer to be welded. The primary, hermetic seal is to be achieved by a low permeance material such as polysobutylene, which is to be continuous and uninterrupted around the perimeter of the glass unit. The secondary seal shall be either polysulphide or silicone. If silicone is used, care must be exercised in the selection and use of setting and edge blocks as well as any other glazing material affecting the performance of the secondary seal.
- .6 Laminated Glass: Shall conform to CAN2-12.1-M76, Type 1, Class B.
- 13. Glazing Materials: Glass spacers and setting blocks shall be compatible with glass edge seals of neoprene rubber, with a durometer between 60 and 80, to ASTM D2240.
 - 1. Glass seats shall be dense EPDM durometer 50 as per ASTM C-509 for capped systems.
 - 2. Thermal separator shall be extruded hard polyvinyl chloride.
 - 3. Materials, recommendations and details describing the proposed use, design and application procedures for glass and glazing materials will be documented and fully described on the shop drawings.
- 14. Weathering Sealant: Shall be approved type as specified under Section 07 92 00 – Building Envelope Sealants. Colour as selected by the Departmental Representative.
- 15. Joint Fillers and Back-up Materials: Shall be selected as per the written recommendations from the applicable sealant manufacturer for each specific application. Shape, size, hardness, compatibility and bond breaking requirements are all factors to be considered.
- 16. Sealant - General: All sealant shall be compatible with adjoining and/or adjacent sealants, back-up materials, substrate materials and their respective finishes.
- 17. Dissimilar Metal Separator: PVC to manufacturer's standard.

2.2 ALUMINUM FINISH

1. All exposed surfaces of exterior and interior aluminum members shall be clear anodized finish in accordance with Aluminum Association AA-M12C22A41, Class 1 specifications. Coating thickness shall be minimum 0.7 mils. Colour shall be colour as selected by the Departmental Representative.
2. Submit duplicate colour samples to the Departmental Representative for final approval.
3. All other aluminum shall have mill finish.
4. Exposed surfaces shall have factory applied removable protective film.

2.3 FABRICATION AND MANUFACTURE

1. All work shall be performed by skilled workers especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed references and standard and/or as specified herein. Work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and adjoining building component tolerances and design criteria. All extruding, forming, welding and cutting operations shall be done prior to finishing.
2. All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, indentations, waves or flaws of any nature impairing strength or appearance; fitted with proper joints and intersections and with specified finishes. All members shall be extruded unless otherwise indicated on the drawings and shall be securely engaged into adjacent components. Extrusions shall be tolerances to eliminate any edge projection or misalignment at joints.
3. All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise required, shall be accurately fitted, rigidly secured with hairline contacts and sealed watertight. Where two or more sections of metal are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any pointing materials.
4. Provide suitable protection against galvanic action wherever dissimilar metals are in contact, as applicable.
5. Insofar as practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily assembled in the shop and marked, before disassembly, to ensure proper assembly later on the works.
6. All fasteners, connectors, anchors including washers and accessory items shall be scheduled and designated on the reviewed shop drawings. Designation shall include material, type, size, spacing and all accessory items.

7. Stamped erection marks shall not be used; all markings shall be removed on completion.

Part 3 Execution

3.1 PREPARATION

1. Obtain all dimensions affecting the work of this section from site. Ensure all adjacent and adjoining materials, flashing, framing, anchors, fastening, etc. are properly set and in readiness to accept the skylight.

3.2 ERECTION

1. All work shall be erected in strict accordance with the reviewed shop drawings by erection forces approved by the fabricator of the skylights under the direct supervision of the fabricator.
2. All parts of the skylight shall be erected plumb and true in proper alignment and relation to established lines and to elevation as shown on reviewed shop drawings.
3. Ensure that intersections, glass or overlapping of aluminum extrusions at junctions of field assembled units do not leave any voids, gaps or wrinkles that would allow the penetration of water into parts of the system.
4. Fasten all aluminum components securely, tight, snug and with neat hairline joints.
5. All fastenings shall be of the concealed type. All bolts, nuts, washers, screws, etc., between steel and steel and between steel and aluminum or between aluminum and aluminum shall be stainless steel.

3.3 GLAZING

1. All glazing shall meet all design and performance requirements specified and shall suit the particular location and conditions for the job; glazing shall be permanently watertight under all conditions, including weather and glazing panel movement.
2. All glazing shall be carried out in accordance with reviewed shop drawings.
3. Face clearance, edge bite and edge clearance of all glass shall be as specified and recommended by the glass manufacturer as minimum necessary to meet all the design and performance requirements specified.
4. Install all glass on glazing blocks and with spacer blocks, both of sizes required and to ensure adequate spaces for glazing.
5. All glass shall be left whole and clean without cracks, scratches or other defects and with all settings in perfect condition at completion, to the satisfaction of the Departmental Representative.

6. All broken or damaged glass due to defective materials or improper setting shall be removed and replaced with perfect materials at the Contractor's expense.

3.4 WEATHERING SEALANT APPLICATION

1. Apply rainscreen sealant to exterior and air seal sealant to joints between skylight and adjoining construction. Provide positive drainage to the exterior.
2. All glass and metal surfaces to be sealed shall be cleaned with an oil free solvent. Sealant shall be applied with caulking gun to provide a regular fillet. Backing rods and bond breakers shall be used as necessary to control joint size and prevent the creation of three sided joints.
3. Sealant materials shall be used in strict accordance with the manufacturer's written instructions and shall be applied only by mechanics specially trained or experienced in their use. Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter shall be completely removed from surfaces it will contact. Adjoining surfaces shall be masked when required to maintain a clean and neat appearance.
4. All joints shall be tooled and exposed sealed joints both taped and tooled. All joints to be sealed shall be thoroughly pretreated to ensure the full bond capabilities of the sealant. Tapes shall be removed as soon as possible after tooling.
5. Sealants, tapes, gaskets, separators, joint fillers and back-up materials shall be physically and chemically compatible with each other and with adjacent materials. Items shall be installed so that they will not become dislodged during or after assembly of units.
6. All metal to metal joints between elements shall be thoroughly sealed by buttering joints with sealant immediately prior to final assembly of abutting sections. Clean all excess sealant from exposed surfaces.
7. Seal all joints as per the applicable sealant manufacturer's recommendations. Clean all excess sealant from exposed surfaces.

3.5 FLASHING AND ACCESSORIES

1. Install aluminum flashings, membranes, closure strips and ridge cap required in connection with skylight as detailed and as required to make the work watertight and weather tight.
2. Flashings shall be formed to suit the various conditions as required and shall be as long as practicable so as to provide the minimum number of joints.
3. Install all rigid or semi-rigid insulation within sections where indicated.

3.6 PROTECTION

1. Be responsible for the protection of the adjacent roof areas from damage during installation of the skylight.

2. Protect all exposed aluminum with removable protective covering, factory or site applied to manufacturer's option. Protective covering shall remain in place until Substantial Performance of the project. Protective covering shall be of a type that will ensure no damage to aluminum finish caused by corrosive materials or construction materials.

3.7 PROTECTION MARKINGS

1. Material for protection markings on glass such as adhesives for manufacturer's labels shall be neutral. In no case shall such materials be alkaline. Any staining of glass or other surfaces by such alkaline materials will be cause for rejection.

3.8 ADJUST AND CLEAN

1. Upon Substantial Performance of the Project, remove factory-applied protective coverings, from exposed surfaces, and clean surfaces free of all smears, marks and discolouration. Cleaning shall be in accordance with applicable provisions of listed standards and the requirements of the skylight manufacturer. All cleaning materials shall be acceptable to the applicable aluminum and glass manufacturers; where doubt exists, make spot tests.
2. Be responsible for immediately cleaning off all smears, marks, etc., caused during erection of the skylight.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section applies to all glass and glazing work not specified in other sections.
- .2 Furnish all labour, materials, equipment and services necessary for the design, fabrication, and supply of all glass and glazing work as indicated on the drawings and as specified. The work of this section shall include, but shall not necessarily be limited to, the following:
 - .1 Sealed insulating glass units to windows, curtain wall system, skylights framing, sash and doors.
 - .2 Triple glazing to exterior curtain wall.
 - .3 Glazing materials, sealants, and glass setting materials that are not normally supplied as part of the framed glazing system, but that are required to glaze the system to the requirements of this specification, and in keeping with published good glazing practices in areas not addressed by this specification.
 - .4 Proof of compliance with design and performance requirements, including copies of manufacturer's published data sheets, test reports, calculations, computer simulations, or other documentation requested.
 - .5 Supply of glass samples.
 - .6 Supply to the Departmental Representative of additional lights of curtainwall vision glass to be used for replacement purposes.

1.2 REFERENCE STANDARDS (MOST RECENT VERSION UNLESS NOTED OTHERWISE)

- .1 National Building Code
- .2 ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtainwalls and Doors by Uniform Static Air Pressure Difference.
- .3 ASTM D2240, Test Method for Rubber Property- Durometer Hardness.
- .4 ASTM E84, Test Method for Surface Burning Characteristics of Building.
- .5 ASTM F1233, Test Method for Security Glazing Materials and Systems.
- .6 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.
- .7 CAN/CGSB-12.8, Insulated Glass Units.
- .8 CAN/CGSB-12.9, Spandrel Glass.
- .9 CAN/CGSB-12.20, Structural Design of Glass for Buildings.
- .10 Glazing Contractors' Association of British Columbia (GCABC) Manual.
- .11 Insulating Glass Manufacturers Alliance (IGMA) Manual.
- .12 Glass Association of North America (GANA) Glazing Manual.

- .13 Flat Glass Manufacturers Association (FGMA) Glazing Manual.
- .14 Laminators Safety Glass Association Standards Manual.
- .15 Sealant, Waterproofing and Restoration Institute (SWRI) publication, *Sealants: The Professionals' Guide 1995*.

1.3 DESIGN AND PERFORMANCE CRITERIA

- .1 Provide continuity of the building enclosure vapour and air barrier:
 - .1 Utilising the inner light of multiple light sealed units.
 - .2 Utilising resilient gasket material to transfer the seal from the glass to the frame of the assembly.
- .2 Size glass to limit glass deflection, withstand wind loads and positive and negative live loads as noted in the B.C. Building Code.
- .3 Design glass to CAN/CGSB 12.20 using an annual probability factor of 1/10 years for the reference wind velocity, and 8 in 1000 glass failure rate under this load assuming glass strength has a coefficient of variation of 0.25. Limit glass deflection to L/175 to a maximum of 20mm under wind load.
- .4 Design glass to withstand thermal stresses imposed in service. In calculation, assume the use of blinds located not less than 50 mm from the inside surface of the glass.
- .5 If areas of vision glass are required to be heat strengthened or glass thickness increased due to wind pressure loads at high pressure zones, then all vision glass on the same elevation shall either be heat strengthened or glass thickness increased to ensure the appearance of all vision glass when viewed from the exterior is consistent. Except where noted specifically otherwise, the decision as to whether the vision glass is required to be heat strengthened or thickened to meet the performance specifications rests solely with the glazing contractor.
- .6 Allow for deflection of building structure and framing members. Ensure no structural loads are imposed on glass.
- .7 Provide edge and face clearances in keeping with glass manufacturers written instructions for each type of glass used.
- .8 Design for the following wind pressures, snow loads, seismic loads, and building movements: found in the B.C Building Code.

1.4 SUBMITTALS

- .1 Submittals to be made in accordance with Section 01 33 00 – Submittals.
- .2 Tender Submission: Provide with tender submission an assessment of the energy calculations using an accepted standard glazing simulation and conforming to CSA A440.2 to confirm the specified design and performance criteria of the curtain wall vision glass. The energy calculation confirmation must be submitted with a seal of a Professional Engineer registered to practice in BC.

- .3 Quality Control Documents:
 - .1 Provide glass manufacturer's product data sheets confirming that glass performance meets the requirements of this specification.
 - .2 Submit letter from insulating glass fabricator stating current IGMA compliance number and identifying the types of edge construction covered by that number.
 - .3 Submit certified test data to show that insulating glass from this supplier, having the same edge construction specified here, has been tested to comply with CAN/CGSB-12.8 within the previous four years.
 - .4 The applicable glass manufacturers shall submit with the curtain wall assembly shop drawings, written certification stating that all glass and glazing materials and requirements as detailed and specified on the shop drawings (designating the shop drawings reviewed by enumerating sheet number, dates and revisions) have been reviewed and approved for use relative to their specific application(s), dimensional design and profile parameters, and conformance to all requirements as detailed and as specified in the drawings and specifications. Identify any specified requirements that are in error or cannot legitimately be met, and provide alternatives that meet the intent of the specification for the Departmental Representative's approval.
 - .5 Submit evidence that glazing contractor is a member in good standing of the Glazing Contractors Association of B.C..
- .4 Shop drawings:
 - .1 Show scale elevations, sections, dimensions, or otherwise schedule quantity and type of glazing to be provided at each location. Indicate clearances to rough opening or to adjacent framing, and maximum tolerances of adjacent construction.
 - .2 Provide details of perimeter and interface conditions. Show relationship to other work, engagement of glass, drainage of glazing channel, location of setting blocks, and placement of sealants and glazing splines or tapes.
 - .3 Show attachment of hardware and identify structural fasteners.
 - .4 Provide information on insulating glass unit makeup. Identify coatings and their location, edge construction, sealants, and any other information required to indicate compliance with contract documents.
 - .5 Submit shop drawings under seal of Registered Professional Engineer.

- .5 Letters of Assurance: The Registered Professional Engineer who signed and sealed the shop drawings shall perform sufficient field reviews in order to provide a letter of professional assurance after completion of the Work, giving assurance that the Work has been fabricated and installed in general conformance with the sealed shop drawings. Approved forms are BC Building Code Letters of Assurance (Schedule C). Written inspection reports of field reviews shall be submitted promptly as the field reviews are made.
- .6 Samples: Samples: Submit colour charts showing all available glazing colours and tints. Three colours/tints may be selected by the Departmental Representative to be provided on sample glass units. Submit duplicate samples of various types of glass units specified or chosen, to the Departmental Representative for final approval. Samples shall be minimum 300 x 300 mm (12" x 12"). Samples to be typical production run quality, complete with tint, frit, primary and secondary edge seals, as applicable. Clearly label each sample with product name, manufacturer's name and project name. Do not order the material without prior approval of colour, tint and appearance by the Departmental Representative.
- .7 Manufacturer's Instructions: Submit manufacturer's installation instructions.
- .8 Closeout Submittals: Provide maintenance data including cleaning instructions for incorporation into manual specified in Section 01 78 23 - Maintenance and Renewal Manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Prevent damage to materials during handling and storage.
- .2 Store packaged material in original containers, with manufacturer's seals and labels intact.
- .3 Packaging and packing of glass to be in accordance with best commercial practice.
- .4 Keep handling to a minimum. Install glass as soon as possible after delivery to site. Avoid prolonged storage of glass at jobsite.
- .5 Store glass vertically, blocked off the floor, in a weather-tight enclosure, in an area not subject to rain, dripping water, condensation, or sunlight. To prevent occurrence of condensation between leaves of stored glass, store at a constant temperature above the dew point.
- .6 Make good or replace scratched or damaged materials as directed, at no additional cost.

1.6 WARRANTY

- .1 All glass and glazing materials to be free from defects in material and workmanship, and continue to perform satisfactorily for a period of one (1) year from certified date of Substantial Performance of the Project.
- .2 The insulated glass units (IGU) are to have a 10-year written warranty.
- .3 The Contractor agrees to correct promptly at its own expense all defects and

deficiencies in the work included in this section. In all cases, defective or deficient work shall be removed and replaced with work acceptable to the Departmental Representative, at no additional cost to the Departmental Representative and at such times as the Departmental Representative may designate.

- .4 For the purposes of this clause but without limiting the generality of this clause; defects or deficiencies shall include:
 - .1 Defects or deficiencies in design, workmanship or materials forming part of the work of this section.
 - .2 “Materials” shall include glass and glazing, aluminum, gaskets, tapes and sealants.
 - .3 With respect to sealed glazing units, hermetic seal failure, fogging, reflective coating defects, low emissivity coating defects, breakdown due to edge flaws (chips, gouges, etc.) migration of edge spacers and breakage due to thermal stress.
 - .4 With respect to frit/scrim defects and breakage due to edge flaws (chips, gouges, etc).
- .5 On or before the certified date of Substantial Performance of the Project, this contractor shall obtain and deliver to the Departmental Representative written warranties or guarantees, in the name of the Departmental Representative, from manufacturers of materials against defects or deficiencies of the type described in this clause.

1.7 MOCK-UP

- .1 Construct mock-ups in accordance with Section 01 33 00 – Submittals.
- .2 Supply and install glass to mock-up framing on building site Construct mock-ups to include glass glazing, and perimeter air barrier and vapour retarder seal.
- .3 Construct mock-ups where directed.
- .4 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with work.
- .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may not remain as part of the finished work.

1.8 QUALITY ASSURANCE

- .1 The glass and glazing work to be done under this section shall be executed by a qualified glazing contractor with at least five (5) years of continual experience in the trade, who shall be prepared to prove to the Departmental Representative’s satisfaction that they have adequate facilities and skilled personnel suitable for the supply and installation of all glass and glazing materials required by this section of work.

- .2 This contractor shall be prepared to prove to the Departmental Representative's satisfaction, that they have adequate facilities and skilled personnel suitable for the design, detailing, fabricating and installation of the glazing assembly.
- .3 Glass and glazing work under this section shall conform to the Insulating Glass Manufacturers Alliance (IGMA) and to the recommendations and specifications of the Glazing Contractors Association of B.C. - Glazing Systems Specification Manual and of the glass and sealed glazing unit manufacturers.
- .4 All glass to bear manufacturer's labels identifying glass type and thickness. Labels to remain on glass until final cleaning.

Part 2 Products

2.1 GLASS PRODUCTS

- .1 Glass: to CAN/CGSB-12.3, glazing quality float unless noted otherwise. Glass thickness not less than 4 mm nor less than that scheduled. Structural requirements may require a greater thickness.
- .2 Heat Treated Glass (tempered and heat strengthened):
 - .1 Flatness and visual quality tolerances to CAN/CGSB-12.1.
 - .2 Glass fabrication(holes and notching) of heat-treated glass, to fabrication requirements of ASTM C 1048.
- .3 Safety Glass: to CAN/CGSB-12.1, tempered.
- .4 Insulating Glass Units: To CAN/CGSB-12.8, triple glazed unit, 37 mm overall thickness, IGMA certified.
 - .1 Unit edge construction to be manufacturer's standard dual seal, with a non-metallic "warm edge" spacer.
 - .2 Unit edge construction for capless (butt-jointed) glazing, humid environments, and sloped glazing to be of dual seal construction, with a non-metallic "warm edge" spacer spacer, primary seal of polyisobutylene and secondary seal of silicone.

2.2 GLAZING MATERIALS (PERFORMANCE TESTED SYSTEMS)

- .1 Exterior and interior glazing gaskets, tapes, sealants, and adhesives; manufacturer's standard, as used in assemblies tested to meet performance criteria for air infiltration and water penetration.
- .2 Glass setting and edge blocks: framing manufacturer's standard products designed to support glass, prevent frame contact, and maintain drainage and venting within the system.
- .3 All glazing materials to be compatible with materials they contact.
- .4 Setting blocks to be compatible with insulating glass edge sealants.

- .5 Sealants in contact with edges of insulating glass to be compatible with insulating glass edge sealants.
- .6 Heel, toe and cap sealants to be compatible with glazing gaskets and glazing tapes.

2.3 GLAZING MATERIALS (GENERIC SYSTEMS)

- .1 Glass setting and edge blocks: neoprene, EPDM or silicone with a Shore A hardness of 80-90 (+/-5) durometer to ASTM D2240, to suit glazing method, glass lightweight and area, formed to allow drainage and ventilation within the glazing pocket.
- .2 Glazing Gaskets: continuous extruded neoprene, silicone rubber or EPDM, as recommended by framing system manufacturer.
- .3 Glazing tapes and sealants as recommended by framing manufacturer. Wet glazing tapes subjected to wind loads must have a continuous integral rubber shim to prevent pump out.
- .4 All glazing materials to be compatible with materials they contact.
 - .1 Setting blocks to be compatible with insulating glass edge sealants. Setting blocks for insulating glass units with silicone perimeter seals must be silicone.
 - .2 Sealants in contact with edges of insulating glass to be compatible with insulating glass edge sealants.
 - .3 Heel, toe and cap sealants to be compatible with glazing gaskets and glazing tapes.

Part 3 Execution

3.1 GENERAL

- .1 Install all materials according to instructions from all product manufacturers. Ensure all materials are compatible with the materials they contact.

3.2 EXAMINATION

- .5 Verify that openings for glazing are correctly sized and within tolerance.
- .6 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
- .7 Ensure that conditions of temperature, humidity and precipitation are suitable for installation, in accordance with manufacturer's instructions. No glazing shall be installed when framing members and other glazing materials are wet or frosted.

- .8 Co-ordinate glass and glazing activities with trades of other sections of this specification when required. Do not install any glazing until all nearby welding, grinding, sandblasting, waterproofing, mortar work and acid etching are complete. When such activities must be carried out in the vicinity of stored or installed glass, provide hoarding or other suitable protection.
- .9 Co-ordinate glass hoisting and handling of glazing materials with the general contractor/project manager.
- .10 Report to the Departmental Representative in writing any defects in existing work, or unsatisfactory site conditions. Start no work until conditions are satisfactory. Starting work shall imply acceptance of existing conditions and surfaces.

3.3 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.4 INSTALLATION

- .1 Install all materials according to manufacturer's instructions, reviewed shop drawings and best practices as described in IGMA and GANA glazing manuals.
- .2 Adjust operable sash before glazing. Glaze operable sash in closed position and is to remain closed until glazing materials have properly cured.
- .3 Provide specified edge and face clearances and glass bite.
- .4 Ensure all weep holes and passages remain free of obstruction.
- .5 Provide safety markings to installed glass by attaching streamers or tape to face of sash. Do not apply tape directly to the glass. Do not mark glass with paint or other substance that is difficult to remove or could leave permanent stains.

3.5 CLEANING

- .1 Remove all protective materials, labels, and other deposits from glazing.
- .2 Clean glass according to instructions from glazing contractor. Cleaning solutions to CAN/CGSB-2.55.

3.6 GLAZING SCHEDULE

- .1 Curtainwall:
 - .1 Glazing Type G3 (vision glass)
 - .1 37 mm overall hermetically sealed unit
 - .2 outer lite 6 mm Azurlite heat-strengthened
 - .3 inner lite 6 mm clear annealed
 - .4 overall performance:

- .1 S.C. = 0.62 – 0.68
 - .2 VLT = 0.72 – 0.76
 - .3 U (Frame and Glass): < 2.0 W/m²K
 - .4 U (Glass) < 0.300 W/m²K
 - .5 Low E on surface #2
 - .6 All units Argon filled
- .2 Fire-rated door and windows:
- .1 Glazing Type G5: Wired glass.
- .3 Skylights:
- .1 Refer to 08 63 00 – Metal-Framed Skylights

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Replacement of drywall that is removed during window and door replacement.

1.2 REFERENCE STANDARDS (Most recent version unless noted otherwise)

- .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C514-04(2014), Standard Specification for Nails for the Application of Gypsum Board.
- .3 ASTM C557-03(2009)E1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- .4 ASTM C840-13, Standard Specification for Application and Finishing of Gypsum Board.
- .5 ASTM C954-15, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- .6 ASTM C1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .7 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .8 ASTM C1178/C1178M-13, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
- .9 ASTM C1278/C1278M-07a(2015), Standard Specification for Fibre-Reinforced Gypsum Panel
- .10 ASTM C1280-13a, Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
- .11 ASTM C1396/C1396M-14a, Standard Specification for Gypsum Board.
- .12 CAN/ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .13 CAN/CGSB 19.21 M87, Sealing and Bedding Compound, Acoustical (Withdrawn)

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Provide manufacturer's technical data for each type of gypsum board.
 - .2 Include product characteristics and performance criteria: fire performance characteristics, moisture vapour permeance, water absorption ratings, compressive strengths, and evaluation reports showing conformance to applicable codes.
- .2 Samples: Submit 600 x 600 mm samples of each type of board specified.

1.4 MOCK-UP

- .1 Provide mock-up of gypsum board installation.
- .2 Locate where directed by Departmental Representative.
- .3 Mock-up may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Minimize time gypsum board products are stored or exposed to sunlight. Keep covered with opaque polyethylene film or light coloured tarpaulins until ready for install.
- .2 Store products away from construction activity and sources of ignition.
- .3 Protect products from damage during handling, installation and at point of installation.
- .4 Exercise care in unpacking, moving, storing, handling and placing panels to prevent damage that may to impair adequacy or appearance.

1.6 AMBIENT CONDITIONS

- .1 Apply gypsum board only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

Part 2 Products

2.1 GYPSUM BOARD

- .1 Interior Gypsum Board: to ASTM C1396/C1396M-14a, Type X, 15.9 mm (5/8") thick, widths to suit framing centers by maximum practical lengths, wrapped tapered edges, square cut ends, fire-rated ULC labelled.

2.2 FASTENERS AND ADHESIVES

- .1 Screws: to ASTM C954-15, for metal or wood framing, wafer head, rust-resistant, Type S-12 drill or Hi-Lo, minimum 31.75mm (1 ¼") length, or Type W rust-resistant, bugle head, course thread, sharp point for wood.
- .2 Adhesive for bonding gypsum board or panels to wood framing: to ASTM C557-03(2009)e1, waterproof, organic type, gun applied.
- .3 Adhesive for laminating gypsum board or panel to gypsum board or panel: as recommended by gypsum board or panel manufacturer, as applicable.
- .4 Laminating Compound: Asbestos-Free

2.3 ACCESSORIES

- .1 Accessories: to ASTM C1047-14a, unless otherwise required for conformance to fire-rated assemblies.
- .2 Casing Beads: to ASTM C1047-14a, fill type, galvanized metal and vinyl extrusion types, perforated flanges, full-length pieces.
- .3 Corner Beads: ASTM C1047-14a, 0.5 mm metal thickness, commercial grade sheet steel with Z275 designation zinc finish, fill type, expanded wing style, full length pieces.
- .4 Jointing Compounds and Tape: to ASTM C475/C475M-15.
- .5 Contractor to confirm installation of interior vapour barrier. If interior vapour barrier is installed use acoustical/Air Barrier Sealants for Concealed Locations: Acceptable product Acoustical Sealant by Tremco Ltd. Meeting requirements of CAN/CGSB 19.21 M87.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine sub-framing to verify that the surface of framing and furring members to receive sheathing does not vary more than 6mm (1/4") from the face of adjacent members.
- .2 Examine and obtain all necessary measurements of previously executed work that may affect the work to this Section.

- .3 Report to Departmental Representative in writing any unsatisfactory conditions before commencing work of this Section. Commencing work shall constitute acceptance of the existing conditions.

3.2 INTERIOR GYPSUM BOARD APPLICATION

- .1 Install gypsum board in accordance ASTM C840 and manufacturer's written instructions. Do not install gypsum board until Departmental Representative has reviewed bucks, anchors, blocking, electrical and mechanical or other work that would be concealed by the gypsum board.
- .2 Apply board to furring and framing using screw fasteners.
- .3 Walls: Provide screws 200 mm o.c. along board edges, 300 mm o.c. throughout board fields or as required by ASTM C840.
- .4 Where interior partitions intersect with exterior walls, run gypsum board through intersection on exterior wall before applying gypsum board to partition.
- .5 Accessories:
- .6 Erect accessories straight, plumb or level, rigid and at proper plane. Use full-length pieces where practical. Make joints tight, aligned accurately and secured rigidly. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm o.c. using screw fastening.
- .7 Use vinyl casing beads along board edges contacting aluminum window/skylight framing to avoid galvanic action if metal beads where used.
- .8 Taping and Filling:
- .9 Finish gypsum board face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to the manufacturer's directions and feathered out onto panel faces.
- .10 Finish corner beads, control joints and trim with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .11 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board to be invisible after finishing completed.
- .12 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .13 Completed installations shall be smooth, level, plumb, free from waves, steps and other defects and ready for surface finish.

- .14 Tape and fill surfaces that will be concealed by cabinets, white/tack boards, wall coverings, and other finishes.
- .15 Tape and fill surfaces that extend above suspended ceilings.
- .16 For water-resistant gypsum board installation, remove excess filler and leave surface ready for installation of ceramic tile.

3.3 PROTECTION

- .1 Do not permit work to be damaged prior to covering. Protect from exposure to harmful weather and physical abuse.
- .2 Remove and replace damaged sheathing.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS (Most recent version unless noted otherwise)

- .1 ASTM B 209, Aluminum and Aluminum Alloy Sheet and Plate.
- .2 CSA B111, Wire Nails, Spikes and Staples.
- .3 CAN/CGSB-93.2, Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use.
- .4 CGSB 93.4 – M92 Galvanized Steel and Aluminum-Zinc Alloy Coated Steel Siding, Soffits, and Fascia, Prefinished, Residential.
- .5 CGSB 93.5, Installation of Metal Residential Siding, Soffits and Fascia.
- .6 CAN/CGSB 41.24, Siding Soffits and Fascia, Rigid Vinyl.

1.2 SUBMITTALS

- .1 Submittals to be made in accordance with Section 01 33 00- Submittals.
- .2 Samples:
 - .1 Submit standard colour charts and samples of standard vent pattern.
 - .2 Submit samples if approval of substitutions is requested.
- .3 Maintenance Data:
 - .1 Provide one (1) carton (12 to 18 pieces minimum) of material for maintenance purposes.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Materials shall not be exposed to wetting or damage and shall be stored neatly, properly stacked.
- .2 Assembled units and/or their component parts shall be transported, handled and stored in a manner to preclude damage of any nature.
- .3 Remove all units or components that are stained, watermarked, cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Protect finish and edges in accordance with manufacturer's directions.
- .5 Store material in accordance with manufacturer's directions.

1.4 MOCK-UP

- .1 Assemble a full-size mockup of the soffit system on the project site for review by the Departmental Representative. Exact area for assembly will be determined by the Departmental Representative. Mock-up shall include all components of the system, including typical joints and connection hardware, and typical tie-ins to adjoining systems, all finished as specified.
- .2 Locate where directed by Departmental Representative.
- .3 Allow for review of mock-up by the Departmental Representative before proceeding with work.
- .4 Mock-up may not remain as part of the Work.

Part 2 Products

2.1 VENTED SOFFIT PANEL

- .1 Aluminum Soffit: To CAN/CGSB-93.2, Type B, Class 1.
 - .1 Colours: colour selected by Departmental Representative.
 - .2 Gloss: High.
 - .3 Profile: flat sheet 'v' crimped for stiffness, vented 0.1 m² of opening for every 30 m² of building area preformed with elongated slits and small perforations.
 - .4 Pattern: plain surface.
 - .5 Thickness: 0.38 mm base metal thickness.
 - .6 Manufacturer and product Name: Deluxe aluminum soffits by Gentek Building Products Ltd.

2.2 ACCESSORIES

- .1 Soffit J-trim, painted both sides.
- .2 Accessories to be of same manufacture as soffit panel and to be utilized in accordance with manufacturer's requirements.
- .3 Fasteners: Nails: To CSA B111. Screws to ANSI B18.6.4. Purpose made stainless steel screws with neoprene washers.

- .4 Sealants: as per Section 07 92 00 – Building Envelope Sealants.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Use skilled workers experienced in panel installation.
- .2 Cut and fit items to adjacent material for tight tailored custom installations.

3.2 INSTALLATION

- .1 Install items level, plumb and straight with ribs parallel, in accordance with details.
- .2 Install panels without waves, warps, buckles, or distortions, and allow for thermal movement considerations.
- .3 J-trim to be installed around all edges.

3.3 TOUCH-UP AND CLEANING

- .1 The Contractor shall remove undue grim and dirt from the cladding by dry wiping the panels as the material is erected.
- .2 Leave soffit system in clean and neat condition.
- .3 At completion of the work, remove any excess materials, debris and equipment pertaining to the work, from the site.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Provide all labour, materials and equipment necessary for the complete supply, surface preparation and application of paint, required to restore original finishes.
- .2 The work of this section shall include, but shall not necessarily be limited to the following:
 - .1 Prime, painting, and finishing of all interior exposed items and surfaces noted on the drawings and indicated in the specifications.
 - .2 Surface preparation, priming, and painting items under other sections specified as shop primed and surface treated.
 - .3 All coating systems materials, including primers, emulsions, stains, sealers, and fillers, and other applied materials used as prime, intermediate or finish coats.

1.2 STANDARD REFERENCES

- .1 New Surfaces: Canadian Painting Contractor's Architectural (CPCA) Painting Specification Manual.
- .2 Existing Surfaces: Maintenance Repainting Guide of the Master Painters and Decorators Association (MPI).

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 – Submittals.
- .2 Before any work is commenced, submit sample panels (24" x 36") of each paint type and colour, specified in colour schedule, for Departmental Representative's review.

1.4 QUALITY ASSURANCE

- .1 Qualification of applicators: This Contractor shall have a minimum of five (5) years proven satisfactory experience. This Contractor shall maintain a qualified crew of painters throughout duration of the work who shall be qualified to fully satisfy the requirements of this specification. Only qualified journeymen shall be engaged in painting and decorating work and have a provincial tradesmen qualification certificate of proficiency.
- .2 Conform to standards contained in MPI Manual, latest edition.
- .3 All paint manufacturers and products shall be as listed under the "Approved Products" section of MPI Manual.
- .4 All painting, unless otherwise specified shall be to MPI Manual, Premium Grade.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Product delivery, storage, and handling of materials shall be in accordance with applicable sections of MPI Architectural Painting Specification Manual. Deliver and store on site in the manufacturer's sealed and labelled containers. Protect latex materials from freezing. Maintain stored materials at a temperature of 8°C or more.
- .2 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion.

1.6 PROTECTION

- .1 Adequately protect all other surfaces from paint and damage and make good any damage caused by failure to provide suitable protection.
- .2 Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted, including surfaces within the storage and preparation area.
- .3 Mask all surfaces not being painted to obtain uniform termination.
- .4 Remove all electrical plates, surface hardware, fitting and fastenings prior to painting operations. Carefully store, clean, and replace upon completion of Work in each area.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 The temperature and moisture content of all the surfaces shall conform to the ratings given in the CPCA Manual or MPDA Manual.
- .2 All areas where painting and decorating work is proceeding required adequate continuous ventilation and sufficient heating facilities to maintain temperature above 10°C for 24 hours before, during, and 24 hours after paint application.
- .3 Do not paint where there is dust in the air.
- .4 Provide adequate illumination on surfaces being painted.

1.8 MAINTENANCE MATERIALS

- .1 At project completion provide 1L (10 qt) of each type of colour to paint from same production run (batch mix) used, in unopened cans, properly labelled and identified for Departmental Representative's later use in maintenance. Store where directed.

Part 2 Products

2.1 MATERIALS

- .1 Use paint materials and products of paint manufacturers listed and approved in MPI Manual and CGSB Qualified Products List. No substitutions.
- .2 All paints shall be Premium Grade; first quality products as manufactured by C.I.L., Bapco Paint Co., Brandram-Henderson Company, Sherwin Williams, Glidden, Pratt & Lambert, Benjamin Moore and General Paint.

- .3 Provide undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- .4 Exterior Painting and Finishing Schedule
 - .1 Unless otherwise indicated, titles and code numbers in the below listed schedule refer to MPI Architectural Painting Specification Manual, Chapter 2, for type surfaces, coating, grade and named products and their manufacturers. Use products from only one manufacturer for each system.
 - .2 Schedule:
 - .1 Concrete Horizontal and Vertical Surfaces: REX 3.1A-Latex-DSD2.
 - .2 Steel and Metal Fabrications: REX 5.1D-Alkyd-DSD2.
 - .3 Galvanized Metal: REX 5.3D-Alkyd-DSD2.
- .5 Interior Painting and Finishing Schedule
 - .1 Unless otherwise indicated, titles and code numbers in the below listed schedule refer to MPI Architectural Painting Specification Manual, Chapter 3, for type surfaces, coating, grade and named products and their manufacturers. Use products from only one manufacturer for each system. Drywall repairs and first coat (primer) of sills, jambs and heads around doors, windows, etc., shall be included in the lump sum costs as indicated on the drawings and the Bid Form.
 - .2 Schedule:
 - .1 **New gypsum board (INT9.2B)**
 - i. Location: replaced drywall
 - ii. Surface Prep: N/A
 - iii. Primer: Later Primer/Sealer
 - iv. Coating: HIPAC Latex
 - v. Grade: Premium
 - vi. Gloss: G3
 - vii. Color: TBD by Departmental Representative
 - .2 **Existing gypsum board (RIN 9.2B)**
 - i. Location: Interior wall to nearest corner
 - ii. Surface Prep: DSD-1
 - iii. Primer: Later Primer/Sealer
 - iv. Coating: HIPAC Latex
 - v. Grade: Premium

- vi. Gloss: G3
- vii. Color: TBD by Departmental Representative

.3 Wood Trim (INT6.3E)

- i. Location: New window trim
- ii. Surface Prep: N/A
- iii. Primer: Semi-Transparent Stain, S.B.
- iv. Coating: Polyurethane Varnish
- v. Grade: Premium
- vi. Gloss: G4
- vii. Color: TBD by Departmental Representative

2.2 MIXING

- .1 Paints shall be ready-mixed unless otherwise specified. The paint shall have good flowing and brushing properties and shall dry or cure free of streaks or sags, to yield the desired finish specified.

Part 3 Execution

3.1 INSPECTION

- .1 Examine all surfaces to be painted before commencing work.
- .2 The commencement of work indicates acceptance of the surfaces and job conditions.

3.2 PREPARATION OF SURFACE

- .1 Prepare surfaces in accordance with the MPI Manual and/or CPCA Manual.
- .2 Preparation of existing exterior surfaces by high-pressure water or other approved method to remove all dust, loose paint, and other deposits on surfaces.
- .3 Remove hardware, hardware accessories, machines surfaces, plates, lighting fixtures, and similar items in place and not to be finished-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
- .4 Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

3.3 APPLICATION

- .1 Perform painting and decorating work in accordance with the standards and requirements incorporated in the CPCA Manual and/or MPI Manual, latest edition.

- .2 Method of paint application shall be either by spray-on or roll-on, sufficient to fill all voids in existing surfaces and provide uniform appearance.
- .3 Apply primer and two (2) coats of approved paint to exposed surfaces of all repaired drywall or masonry surfaces, maximum coverage rate of 250ft² per imperial gallon per finish coat.
- .4 Apply two (2) coats of approved paint to all miscellaneous metal fabrications, maximum coverage rate 150ft² per imperial gallon per coat.
- .5 Flammable rubbish, cotton waste, cloths and material, which may constitute a fire hazard, shall be placed in closed metal containers and removed daily from the site.
- .6 Protect all signs and fixtures attached to the walls. Uncover and clean when painting has been completed.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Work and conditions common to Division 23

1.2 RELATED SECTIONS

- .1 Division 01 General Requirements
- .2 Section 00 01 50 – General Instructions
- .3 Section 23 05 49 - Seismic Restraints
- .4 Section 23 08 00 - Commissioning of Mechanical Systems

1.3 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 WORK INCLUDED

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

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

1.5 SUSTAINABLE REQUIREMENTS

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

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 COORDINATION

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

1.8 HOISTS AND SCAFFOLDS

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

1.9 INSPECTION OF WORK

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

1.10 PERMITS

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

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

1.11 CODES, REGULATIONS AND STANDARDS

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

1.12 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions and Division 01.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period described in Division 01 and General conditions, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.
- .4 This Contractor shall, at their own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the guaranty-warranty.

1.13 ENERGY CONSUMPTION

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

1.14 WORKMANSHIP

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

1.15 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

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

1.16 SHOP DRAWINGS/PRODUCT DATA

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

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

- .4 Format
 - .1 Black line prints 216 mm x 280 mm or 280 mm x 430 mm.
 - .2 Larger drawings may be submitted on reproducible sepia with space for stamps and signatures - master set plus one working copy.
 - .3 An assembly of related components, e.g. grilles, registers and diffusers or radiation with sheet metal cabinets, etc. between covers with the contents, identified by model number, listed on the front cover with item identification numbers.
 - .4 A brochure for plumbing fixtures between covers with the contents named with model numbers listed on the front cover with item identification numbers.
- .5 Number of copies
 - .1 Provide number of copies indicated in Section 01 33 00 - Submittal Procedures.
- .6 Coordination
 - .1 Where mechanical equipment requires electrical connections, power or other services, the shop drawings shall also be circulated through the Electrical Contractor (or other "services" contractor(s)) prior to submission to the DCC Representative.
- .7 Keep one (1) copy of shop drawings and product data, on site, available for reference.

1.17 DUCT AND PIPE MOUNTED CONTROL EQUIPMENT

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

1.18 SPARE PARTS

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

1.19 PROJECT CLOSE-OUT REQUIREMENTS

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

1.20 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
 - .1 Commission all systems and prove out all components, interlocks and safety devices.
 - .2 Submit a letter certifying that all work (including calibration of instruments and balancing of systems) is complete, operational, clean and all required submissions have been completed.

- .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Testing and balancing completed.
 - .3 Operating and Maintenance Manuals completed.
 - .4 "As Built" Record Drawing ready for review.
 - .5 System Commissioning has been completed and has been verified by the Departmental Representative.
 - .6 All demonstrations to the Departmental Representative have been completed.
- .3 The work will not be considered to be substantially complete until the following requirements have been met:
 - .1 All items listed in .1 and .2 above have been completed.
 - .2 Gas Inspection - Certificate of inspection.
 - .3 Seismic letters of Assurance and final inspection report.
 - .4 Certificate of Substantial Performance.
 - .5 Signed off copy of final inspection report.

1.21 OPERATING AND MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into a complete project manual.
- .2 Definition: detailed information and records of individual products provided by manufacturer or supplier as part of project requirements, and of systems, describing operation and maintenance of each item.
- .3 Operating data to include:
 - .1 Environmental and other control schematics for each system.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operating instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Colour coding chart.

- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operating and trouble-shooting instructions for each item of equipment.
 - .2 Equipment manufacturer's performance data sheets.
 - .3 Equipment performance verification test results.
- .5 Approvals:
 - .1 Submit (2) drafts of Operating and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by the Departmental Representative.
 - .2 Make any changes in submission as may be required and re-submit as directed.

1.22 RECORD DRAWINGS

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

Part 2 Products

NOT USED

Part 3 Execution

3.1 CONCEALMENT

- .1 Conceal all piping, ductwork and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install piping and conduit in outside walls or roof slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.

3.2 ACCESSIBILITY

- .1 Install all work so as to be readily accessible for adjustment, operation and

maintenance. Furnish access doors where required in building surfaces for installation by building trades. Refer to item "Access Doors".

3.3 PROTECTION OF WORK

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

3.4 CUTTING, PATCHING, DIGGING, CANNING AND CORING

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

3.5 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa (refer to structural drawings).

- .2 All inserts supporting piping shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 Cast-in-place type:
 - .1 Channel type
 - .2 Wedge type galvanized steel concrete insert, rated for the duty, for up to 200 mm pipe size.
 - .3 Universal type malleable iron body insert, rated for the duty, for up to 200 mm pipe size.
 - .4 Screw concrete insert, rated for the duty, for up to 300 mm pipe size.
 - .2 Drilled, mechanical expansion type:
 - .1 Heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa.
 - .2 Stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Drop-in anchor for concrete.
 - .4 Sleeve Anchor (medium and light duty) for concrete and masonry.
 - .5 Pin bolt (light duty) for concrete and masonry.
 - .3 Drilled, adhesive type:
 - .1 Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Anchor rod with a 2 part adhesive system.
 - .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
 - .4 Rod assemblies shall extend a minimum of 50 mm into the concrete slab below the housekeeping bases.
- .3 Note:
 - .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.
 - .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

3.6 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

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

3.7 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

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

3.8 PIPE SLEEVES

- .1 Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves to be concentric with pipe.
- .2 Pipes and ducts passing through fire rated separations that have no fire resistance (non-rated separations) do not require a sleeve, but the insulation at the separation should be wrapped with 0.61mm thick galvanized sheet steel band to which to apply the flexible caulking compound to.
- .3 Pipe sleeves for floors and interior walls shall be minimum 0.61mm thick galvanized sheet steel with lock seam joints.
- .4 Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 150 mm beyond sleeve diameter. Annular fin shall be embedded into centre of wall.
- .5 Pipe sleeves for wet or washdown floor areas such as washrooms, janitors rooms and mechanical equipment rooms shall be Schedule 40 steel pipe.
- .6 Except as otherwise noted pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .7 Pipe sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.
- .8 Pipe sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.
- .9 Pipe sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.

- .10 Sleeve Size: 12 mm clearance all around, between sleeve and pipe or between sleeve and pipe insulation.
- .11 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .12 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.9 ESCUTCHEONS AND PLATES

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

3.10 EQUIPMENT SUPPORTS

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

3.11 EQUIPMENT RESTRAINTS

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

3.12 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

3.13 ANCHOR BOLTS AND TEMPLATES

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

3.14 MISCELLANEOUS METAL

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

3.15 FLASHING

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

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

3.16 DELECTRIC COUPLINGS

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

3.17 PAINTING

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

- .6 Painting by Painting trade shall be in accordance with the following Colour Schedule for Mechanical Equipment Areas:

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

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

3.18 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping systems.
- .2 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.

- .3 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.
- .4 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .5 Provide, install and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.

3.19 START-UP

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Section 23 05 49 - Seismic Restraints

1.3 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2007, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-1996 (R2007), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 Thermal Insulation Association of Canada (TIAC)

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 and ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

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

1.5 SUBMITTALS

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

1.6 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .2 Check sheets to include the following information:
 - .1 Pipe or ductwork system
 - .2 Equipment number, make and model, including weights
 - .3 Pipe support type and spacing

- .4 Pipe support finish (corrosion protection, painted)
- .5 Details of pipe attachment to structure
- .6 Hanger details at pipe insulation (where applicable and specified)
- .7 Comments on seismic installation
- .3 For each tabulated item, state the following:
 - .1 Does the item comply with the specification? Yes/No/Not Applicable.
 - .2 Identify any areas of non-compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

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

2.2 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

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- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.3 WALL SUPPORTS

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

2.4 FLOOR SUPPORTS

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

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.
- .2 Calculations shall be signed and sealed by Professional Engineer certified in BC.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.7 OTHER EQUIPMENT SUPPORTS

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

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Section 23 05 49 - Seismic Restraints
- .2 Section 23 33 00 - Air Duct Accessories

1.3 REFERENCES

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

1.4 SUBMITTALS

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

Part 2 Products

2.1 GENERAL

- .1 Provide vibration isolation on all motor driven equipment with motors of 1/2 HP and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 1/2 HP, provide vibration isolation grommets at the support points.

- .2 Provide seismic restraint for all equipment including all seismic restraint related hardware (bolts and anchors) from point of attachment to equipment through to and including attachment to structure. The required anchors shall be indicated on the shop drawings and shall be clearly identified for the correct location and so as to be readily identified after installation. Provide clear instructions for their installation. Refer to Section 23 05 49 - Seismic Restraints.
- .3 Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval.
- .4 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.
- .5 Isolators and restraining devices, which are factory supplied with equipment, shall meet the requirements of this section.
- .6 Provide concrete inertia bases or structural steel bases, where specified or required by equipment manufacturers, located between vibrating equipment and the vibration isolation elements, unless the equipment manufacturer certifies direct attachment capabilities.
- .7 Coordinate for the provision of housekeeping pads at least 100 mm high under all isolated equipment, or greater thickness where specified. Provide at least 300 mm clearance between drilled inserts and edge of housekeeping pads. Housekeeping pads to be tied to structure with reinforcement to meet Code seismic requirements.
- .8 For isolated equipment, design anchors, bolts, isolators and bases to meet Code requirements. For larger isolators, where the Code requirement cannot be met by the isolator housing, provide Type 6 seismic snubbers or Type 6P where post-disaster requirement is specified.
- .9 Use ductile materials in all vibration and seismic restraint equipment.
- .10 Follow Structural Engineer's instructions for drilled inserts re: installation of anchors.
- .11 Coordinate with Section 23 33 00 - Air Duct Accessories for all ductwork connections to fans or plenums.
- .12 Provide flexible connectors between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in the piping system. Meet connector manufacturer's installation specifications as well as equipment manufacturer's requirements.

- .13 Coordinate with Electrical Division 26 for the provision of a minimum 180⁰ hanging loop of flexible conduit for all electrical connections to isolated equipment.
- .14 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the contractor.

2.2 ISOLATORS - GENERAL

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

2.3 ISOLATORS – TYPE 1, PADS

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

2.4 ISOLATORS – TYPE 2, RUBBER FLOOR MOUNTS

- .1 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 4 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 to oil in the mechanical room.

2.5 ISOLATORS – TYPE 3, SPRING FLOOR MOUNTS

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

2.6 ISOLATORS – TYPE 4, HANGER MOUNTS

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

2.7 CLOSED CELL FOAM GASKETS/NEOPRENE GROMMETS – TYPE 7

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

2.8 PIPE RISER GUIDE/ANCHOR – TYPE 8

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

2.9 FLEXIBLE CONNECTORS – TYPE 9

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

2.10 STEEL BASES

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

2.11 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

Part 3 Execution

3.1 INSTALLATION

- .1 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by 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, etc.
- .3 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) anchors and/or welding.
- .4 After installation and adjustment of isolators verify deflection under load to ensure loading is within specified range and isolation is being obtained.
- .5 Where hold down bolts for isolators or seismic restraint equipment penetrate roofing membranes, provide "gum cups" and sealing compound to maintain waterproof integrity of roof. Ensure sealing compound is compatible with isolator components such as neoprene. Co-ordinate with roofing section of specifications and with roofing subcontractor.
- .6 Under equipment mounted on Type 3 mounts, which do not meet the seismic requirement, provide Type 6 seismic snubbers.
- .7 Select Type 4 spring hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units, emergency generator exhaust piping and silencers, steam PRV's and any other vibrating sources.
- .8 Isolate axial fans rotating at more than 1170 RPM on type 2 isolators.
- .9 Use the lowest RPM scheduled for two-speed equipment in determining isolator deflection.
- .10 Where ductwork, piping or boiler exhaust stacks, etc., connected to or serving noise generating equipment, is routed through walls, floors, piping chases, etc. position ductwork, piping, stacks, etc. to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise. Use Type 2 and Type 8 mounts. Submit proposed details to meet this requirement. This requirement includes piping from chiller and emergency generator exhaust.
- .11 Provide Type 8 resilient elements in pipe anchors, where pipe anchors are within 12 m of a vibrating source or if located in pipe chases.
- .12 Protect neoprene isolator components from overheating or use type 8 mounts.

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

3.2 INSPECTIONS

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

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Once during the installation, at 50% completion stage.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

- .1 SMACNA – Seismic Restraint Manual – Guidelines for Mechanical Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 National Building Code of Canada (NBC) – 2015

1.3 DEFINITIONS

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

1.4 SCOPE OF WORK

- .1 Provide restraint on all piping, ductwork, equipment and machinery, which is part of the building mechanical and process systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake. This specification covers equipment, which is not specifically covered in SMACNA.
- .2 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.
- .3 When equipment is mounted on concrete housekeeping pads, and / or concrete curbs the anchor bolts shall extend through the pad into the structure.
- .4 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .5 Seismic restraints may only be omitted where permitted by SMACNA.
- .6 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia. Provide Letters of Assurance (APEGBC Schedules S-B, S-C).

1.5 SUBMITTALS

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

- .5 Quality assurance submittals: Submit the following in accordance with the requirements in Section 01 33 00 – Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .6 Letters of Assurance (APEGBC Schedules S-B, S-C) from Contractor's Seismic Engineer.
- .7 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 SRS MANUFACTURER

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

2.2 GENERAL

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

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.
 - .3 Use size of bolts scheduled in approved shop drawings.

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

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

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

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

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

Part 3 Execution

3.1 GENERAL

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

3.2 AIR TERMINALS

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

3.3 NON-ISOLATED FLOOR MOUNTED EQUIPMENT

- .1 Not used.

3.4 ISOLATED PIPING AND EQUIPMENT

- .1 Install cables using appropriate grommets, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.
- .2 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.
- .3 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.
- .4 On piping systems, provide transverse slack cable restraints at a maximum spacing of 10 m and longitudinal restraints at 20 m maximum spacing, or as limited by anchor/slack cable performance. For pipes greater than NPS10, reduce transverse restraint spacings to 6.0 m.
- .5 Small pipes may be rigidly tied to big pipes for restraint, but not the reverse.

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

3.5 FIELD QUALITY CONTROL

- .1 Inspection and Certification:
 - .1 SRS: inspected and certified by Contractor's Seismic Engineer (who signed shop drawings) upon completion of installation.
 - .2 Provide written report to Departmental Representative with Letters of Assurance (APEGBC Schedules S-B, S-C).
- .2 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 23 05 00 – Common Work Results for HVAC

1.3 REFERENCES

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

1.4 SUBMITTALS

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

1.5 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Submit all information and material required for the Quality Management System, in accordance with the Submittal Procedure requirements in Section 01 33 00- Submittal Procedures.
 - .3 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet

- .4 Quality Control Check Sheet:
 - .1 Prepare and maintain Quality Control Check Sheets.
 - .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.
 - .3 Check sheets to be filled in and submitted for review, prior to substantial completion.
 - .4 Tabulated check list including the following:
 - .1 Equipment number and type
 - .2 System type
 - .3 Equipment and system location
 - .4 Identification completed
 - .5 Spacing as specified
 - .6 Visible from all areas
 - .7 Match existing identification
 - .8 Corrosion resistant nameplates, tags and ties
 - .9 Valve schedule and identification chart
 - .5 For each tabulated item, state the following:
 - .1 Does the item comply with the specification? Yes/No/Not Applicable.
 - .2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

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

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

- .4 Lettering and numbers raised or recessed.
- .5 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 SYSTEM NAMEPLATES

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

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

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.
- .5 Identify all systems and areas or zones of building being serviced.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.
 - .1 Paint all natural gas piping yellow.
 - .2 Sprinklers: to NFPA 13.
 - .1 Paint all sprinkler piping red.
 - .3 Standpipe and hose systems: to NFPA 14.
 - .1 Paint standpipe and hose system piping red.

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 or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.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
Natural gas	to Codes	BLACK
Gas regulator vents	to Codes	BLACK

2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

2.7 VALVES, DAMPERS, CONTROLLERS

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

2.8 CONTROLS COMPONENTS IDENTIFICATION

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

2.9 LANGUAGE

- .1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

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

3.3 INSTALLATION

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

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas, in mechanical rooms, equipment rooms, crawlspace: at not more than 15 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas, service spaces and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with UV rated plastic tie wraps.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively, unless noted otherwise.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Testing, Adjusting and Balancing (TAB) is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for all HVAC, plumbing and some specific process systems in the facility.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.
- .3 Supplemental requirements: Measure all existing HVAC outlets within each served prior to demolition. Submit report for record. Report shall be used to balance new HVAC equipment. Balance new HVAC equipment to match pre-renovation air quantities, unless noted otherwise. See drawing M002 for HVAC zoning diagram.

1.2 SUBMITTALS

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

1.3 QUALIFICATIONS OF TAB COMPANY AND PERSONNEL

- .1 Testing, Adjusting and Balancing Company shall meet the following qualifications:
 - .1 Minimum of ten years of recent experience in testing and balancing of mechanical systems, for a variety of industrial processes and systems.
 - .2 The senior site technologist/technician must have a minimum of ten years TAB experience of similar industrial projects.
 - .3 Submit names of personnel to perform TAB to the Departmental Representative within 30 days of award of contract.
 - .4 Provide documentation confirming qualifications, successful experience.
 - .5 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB), Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2006.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing Procedural Guide, 2003.
 - .6 Use TAB Standard provisions, including checklists, and report forms; submit final report at the completion of the project. Include report in the maintenance manual.
 - .7 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
 - .8 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
 - .9 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges (simulate filter loading, outdoor air provision, etc).
- .4 Note that there is some overlap in responsibility between this section and Section 23 08 00 - Mechanical Commissioning.

1.5 EXCEPTIONS

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

1.6 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.

1.7 PRE-TAB REVIEW

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

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 seven (7) days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, and caulking.

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

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, 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 a list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 1 month of TAB. Provide certificate of calibration to Departmental Representative.

1.13 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.

1.14 TAB REPORT

.1 Format in accordance with SMACNA Guidelines.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 4 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index and index tabs.

.4 Include final TAB report in maintenance manual.

1.15 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.

1.16 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.17 COMPLETION OF TAB

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

.2 Include final TAB report in the maintenance manual.

1.18 TAB GENERAL

.1 Standard: TAB to most stringent of this section or TAB standards of SMACNA or ASHRAE.

.2 Do TAB of following systems, equipment, components, controls:

.1 Supply air system(s).

.2 Return air system(s).

- .3 Exhaust air system(s).
- .3 The TAB agency shall be responsible to the Contractor but report jointly to the Departmental Representative and the Contractor. Report in writing to the Departmental Representative any lack of cooperation and any discrepancies or items not installed in accordance with the contract documents.
- .4 Procedures shall be in general accordance with AABC's National Standards for Field Measurement and Instrumentation and ASHRAE Standards.
- .5 The TAB agency shall agree to perform spot checks, where requested, in the presence of the Departmental Representative.
- .6 Work with the TAB agency to:
 - .1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.
 - .2 Make corrections to achieve system balance without delay, include all corrections made during the balancing procedure on "As Built" Drawings. Mechanical Contractor to provide "As Built" information to the balancing agency before balancing commences.
 - .3 Adjust fan drives and change sheaves and belts as directed by the agency. Allow for the cost of the replacement sheaves and belts.
 - .4 Maintain all systems in full operation during the complete testing and balancing period.
 - .5 Employ control technicians to make adjustments to the control systems to facilitate the balancing process.
 - .6 Employ the journeyman millwright to check the alignment of any V-belt drives and/or shaft coupling drives if they have been adjusted during the balancing process. Belt tension correctness to be verified.
- .7 Consult with the Departmental Representative to clarify the design intent where necessary or in case there are any problems foreseen as the balancing processes.
- .8 Complete air balance before commencing water balance where heating/cooling coils are installed in the air system. Balancing shall not commence until systems have been cleaned and treated and the air removed from within the piping systems.
- .9 This TAB agency shall remove and re-install ceiling tile to provide access to ductwork and piping. The TAB agency will make good any damage or soiling caused by his forces.
- .10 Permanently mark final settings on valves, dampers and other adjustment devices. Set and lock all memory stop balancing devices.

- .11 Seal all holes with snap plugs or approved alternate method, used for flow and pressure measurements.
- .12 The controls contractor and TAB agency are to allow for checking and making adjustments during the 12 month warranty period, when weather conditions provide natural loads and in cases where complaints arise.
- .13 Submit a draft balance report to the Departmental Representative for approval and submit approved copies to the agency preparing the O & M manuals for inclusion in each operating and maintenance manual. Provide field notes in the balancing report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment. Identify outstanding problems that cannot be corrected by the balancing team or that will not be corrected by the installing trades (e.g. in cases where additional balancing dampers are required).
- .14 Submit a statutory declaration to the Departmental Representative, certifying that the testing and balancing procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and, finally, that follow-up testing, after correction of faults and omissions, has been completed and recorded. Reports to be signed by the senior member of the TAB agency.
- .15 Employ the testing and balancing agency to test all fire dampers as follows:
 - .1 Test all fire dampers. The test shall be made by releasing the fusible link and witnessing closure of the damper. All fire dampers shall be left in the open position.
 - .2 A set of prints shall be marked up to show that each damper has checked for closure, accessibility and installation or provide schematic mechanical drawing showing all fire damper locations, label all fire dampers on drawing and reference made in the completed test certificate submitted to the Departmental Representative.
- .16 The Balancing Agency shall include for 10 (ten) days of return visits for readjustment of systems after the building is occupied and used.

1.19 AIR SYSTEMS TAB

- .1 Quality assurance: perform TAB under direction of supervisor qualified to standards of Associated Air Balance Council (AABC), National Standards for Total System Balance or National Environmental Balancing Bureau (NEBB) “Procedural Standards for Testing, Adjusting and Balancing Environmental Systems”.
- .2 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

- .3 Systems Data – the following information shall be provided:
 - .1 Air Handling Equipment:
 - .1 Design Data:
 - .1 Total air flow rate;
 - .2 Fan total static pressure;
 - .3 System static pressure;
 - .4 Motor kW, r/min, amps, volts, phase;
 - .5 Outside air flow rate L/s;
 - .6 Fan r/min;
 - .7 Fan kW;
 - .8 Inlet and outlet, dry and wet bulb temperatures.
 - .2 Installation Date:
 - .1 Manufacturer and model;
 - .2 Size;
 - .3 Arrangement discharge class;
 - .4 Motor type, kW, r/min, voltage, phase, cycles, and load amperage;
 - .5 Location and local identification data.
 - .3 Recorded Data:
 - .1 Air flow rate;
 - .2 Fan total static pressure;
 - .3 System static pressure;
 - .4 Fan r/min;
 - .5 Motor operating amperage;
 - .6 Inlet and outlet, dry and wet bulb temperatures.
 - .2 Duct Air Quantities: All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum), major return air openings back to duct shafts or air handling units.
 - .1 Duct sizes;
 - .2 Number of pressure readings;
 - .3 Sum of velocity measurements;
 - .4 Average velocity;

- .5 Dust recorded air flow rate;
- .6 Duct design air flow rate.
- .3 Air Inlet and Outlets:
 - .1 Outlet identification location and designation;
 - .2 Manufacturers catalogue identification and type;
 - .3 Application factors;
 - .4 Design and recorded velocities;
 - .5 Design and recorded air flow rates;
 - .6 Deflector vane or diffuser cone settings.
- .4 Air Heating and Cooling Equipment
 - .1 Design Data:
 - .1 Heat transfer rate;
 - .2 Liquid and air flow rates;
 - .3 Liquid pressure drop;
 - .4 Air static pressure drop;
 - .5 Entering and leaving liquid temperatures;
 - .6 Entering and leaving air dry and wet bulb temperatures;
 - .7 Fluid and air side pressure drops.
 - .2 Installation Data:
 - .1 Manufacturers, model, type;
 - .2 Entering and leaving fluid flow and temperatures
 - .3 Entering and leaving fluid flow and temperatures
 - .4 Fluid and air side pressure drops
 - .3 Recorded Data:
 - .1 Element type and identification (location and designation);
 - .2 Entering and leaving air dry and wet bulb temperatures;
 - .3 Entering and leaving water temperatures;
 - .4 Water pressure drop;
 - .5 Air static pressure drop;
 - .6 Air and water flow rates;
 - .7 Adjusted temperature rise or drop.

- .4 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
- .5 Adjust duct and terminal balance dampers, and adjust or change drive sheaves and fan blade pitch angles to obtain design quantities (within +/-10%) at each outlet and inlet.
- .6 Use terminal balance dampers to regulate air quantities only to the extent that adjustments do not create objectional air motion or sound levels. The sheet metal sub contractor shall provide additional dampers where required by the balancing agency to achieve a satisfactory balance without creating noise problems.
- .7 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area of duct. Provide a "Pitot Tube" traverse test sheet for each major duct branch.
- .8 Measure air quantities at each air terminal.
- .9 Maintain the design relationship between the supply and exhaust air system quantities.
- .10 Check to ensure that supply and return air quantities provide reasonable building pressurization. Document abnormal building leakage conditions noted.
- .11 Adjust the air terminals to obtain the optimum air distribution pattern.
- .12 Controllers on heating coils are to be checked by the controls contractor and the commissioning agent and they shall also verify that room thermostats / sensors are cycling valves properly.
- .13 Air systems shall be balanced with clean filters in place, at a total of 105% to 110% of specified total airflow rates.
- .14 Where variable air volume systems are installed, take measurements at maximum and minimum flows. Record the minimum operating duct static pressure set-point for each air handling system.
- .15 In conjunction with the Controls Contractor set and verify the outdoor air damper minimum position. The balancing agent shall measure the O/A volume during minimum O/A condition when the air valves/mixing boxes are at a simulated minimum system condition.
- .16 Balance all air systems for 100% outdoor air and 100% relief air. Upon completion of each system balance, check to ensure that the fan motor does not overload and that the main duct pressure does not change substantially when the system is switched over to minimum O/A condition.
- .17 Include in the air balance report:
 - .1 Date of test, Name and address of building and balancing technician's name.

- .2 Range of outdoor air temperature during the balancing period.
- .3 System schematics indicating damper positions, design and measured air quantities at each inlet and outlet. Show room numbers and floors.
- .4 If installation permits, record both air terminals and fan discharge traverse air volumes to establish system leakage.
- .5 Main branch duct traverses. Maximum and minimum outdoor air quantities.
- .6 Static pressure across each component in an air handling system at full flow.
- .7 Face velocities across major components such as filter or coils.
- .8 Static pressure across each fan.
- .9 System static pressures at selected points throughout a VAV supply duct system and in main branch ducts in low velocity systems.
- .10 Fan and motor speed.
- .11 Motor size, starting time, amps and voltage.
- .12 Coil air entering and leaving temperatures (D.B. and W.B.).
- .13 Maximum and minimum zone supply air temperatures under prevailing conditions at time of test.
- .14 Provide fan performance curve for each new air handling system.
- .15 Pressure differences between "refuge areas" and adjacent spaces.

1.20 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Quality assurance: as for systems specified in this section.
- .2 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.

1.21 POST-OCCUPANCY TAB

- .1 Participate in systems checks twice during Warranty Period - approximately 3 months after acceptance and within 2 months of termination of Warranty Period.
- .2 Include for two days on site for checking and system balance modifications during each visit.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

1 MECHANICAL FORMS

1.1 MF 100 Check List – Submissions to Departmental Representative

ITEM	CHECKED BY	DATE
10 WORKING DAYS BEFORE CLOSE OF SUBTRADE TENDER – Request for addition of acceptable manufacturers		
10 DAYS AFTER AWARD OF THE CONTRACT – List of equipment suppliers and subtrades – Shop Drawings		
PRIOR TO CLOSING IN CEILINGS & SHAFTS – Duct test data – Pictures of installation		
PRIOR TO STARTING SYSTEMS – Checklists for start-up (MF 151)		
PRIOR TO COMMISSIONING SYSTEMS – Checklists for operation (MF 151) – Commissioning schedule		
PRIOR TO DEMONSTRATION OF SYSTEMS – Demonstration agenda		
10 DAYS PRIOR TO SUBSTANTIAL PERFORMANCE INSPECTION – Submission of items listed on Form MF-188		
WHEN REQUESTING INSPECTION OF OUTSTANDING WORK – Certificate of total completion (MF 192) – Checklist of work remaining (MF 191) – Checklists of Demonstrations (MF 181, 182)		

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

System: _____

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

NOTES:

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

1.2 MF 170 Certificate of Testing and Balancing

I hereby declare that I _____

I am an employee/a principal of _____

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

SIGNED _____ DATE _____

NOTES:

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

1.3 MF 171 Certificate of Duct Cleanliness

I hereby certify that I _____

I am an employee/a principal of _____

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

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

SIGNED _____ DATE _____

NOTES:

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

1.4 MF 174 Certificate of Seismic Restraint Installation

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

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

SIGNED _____ DATE _____

NOTES:

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

1.5 MF 175 Certificate of Vibration Isolation

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

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

SIGNED _____ DATE _____

NOTES:

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

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

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

NOTES:

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

1.7 MF 181 Check List – Demonstration of Air Handling Systems

System: _____

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

NOTES:

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

1.8 MF 188 Check List – Substantial Completion Submissions - HVAC

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

NOTES:

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

1.9 MF 190 Certificate of Substantial Performance Division 23

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

of

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

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

SIGNED _____

DATE _____

NOTES:

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

1.10 MF 191 Check List – Work Remaining After Substantial Performance

		COMPLETION		
ITEM NO.	DESCRIPTION	CLAIMED BY	DATE	VERIFIED DATE

NOTES:

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

1.11 MF 192 Certificate of Total Performance – Division 23

I hereby certify that I _____

am an employee / a principal / an agent

of _____

and have personally witnessed that each item of outstanding work on the checklist and record of work remaining after substantial completion MF 191 (attached) has been satisfactorily completed and I hereby certify that the

Mechanical systems work specified on the above project is complete.

SIGNED _____ DATE _____

NOTES:

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

END OF SECTION

Part 1 General

1.1 GENERAL

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

1.2 REGULATORY REQUIREMENTS

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

1.3 QUALIFICATIONS AND SAMPLES

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

Part 2 Products

2.1 EXTERNAL FLEXIBLE INSULATION

- .1 External flexible glass fibre insulation with integral vapour barrier.
 - .1 Minimum density - 12 kg/cu.m. [3/4 lbs/cu. ft.].
 - .2 Thermal Conductivity at 24 deg.C. - 0.042 W/m/deg.C.

2.2 DUCT LINER

- .1 Rigid Acoustic Duct Liner
 - .1 Yellow or light coloured internal rigid glass fibre acoustical insulation with black sealer coating on one face.
 - .2 Minimum sound absorption (NRC) of 0.60 as tested per ASTM C423 using type "A" mounting.
 - .3 Thermal Conductivity at 24 deg.C. - 0.035 W/m/deg.C.

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

2.3 ACCESSORIES

- .1 Insulation Adhesive
 - .1 As recommended by the insulation manufacturer.
- .2 Vapour Barrier Tape
 - .1 Finishing tape as commercially available to meet flame spread rating and smoke developed classification requirements of NBC 1985 and compatible with facing material.
 - .2 Scrim foil self-adhesive tape.
- .3 Vapour Barrier Adhesive
 - .1 As recommended by the vapour barrier manufacturer.
- .4 Insulation Coating
 - .1 As recommended by the insulation manufacturer.
- .5 Weather Coating - vapour barrier
 - .1 As recommended by the vapour barrier manufacturer.
- .6 Reinforcing Membrane
 - .1 Glass reinforcing membrane as commercially available.
- .7 Seal Coating
 - .1 As recommended by the insulation manufacturer.
- .8 Fabric Adhesive
 - .1 As recommended by the insulation manufacturer.
- .9 Fabric Coating
 - .1 As recommended by the insulation manufacturer.

2.4 SCOPE OF INSULATION

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

Service	Thickness	
	Mm	[ins]
All cooling and heating supply ducts; - where the temperature difference between the space within which the duct is located and the design air temperature in the duct, is <u>less than or equal</u> to 22.2°C [40°F]	40	[1.5]
All cooling and heating supply ducts; - where the temperature difference between the space within which the duct is located and the design air temperature in the duct, is <u>greater than</u> 22.2°C [40°F].	50	[2]
Combustion intake / relief air	50	[2]
Exhaust air discharge through roof (including sides and bottom of plenum).	50	[2]
Exhaust air ductwork outside the building.	25	[1]
All exhaust air ductwork from outside wall or roof to 1.5 m [5 ft.] inside building.	25	[1]

.2 Scope 2: Internal Flexible Acoustic Duct Liner

Service	Thickness	
	mm	[ins]
All ductwork where indicated by cross hatching	as indicated on drawings	
All exposed supply ductwork in the mechanical room (from A.H.U. discharge to duct shaft)	50	[2]

.3 Scope 3: Internal Rigid Acoustic Duct Liner

Service	Thickness	
	mm	[ins]
Cold and hot supply air plenums. Line walls, tops and bottoms from discharge dampers to supply duct connections.	50	[2]
Supply and Return air plenums within 3 meters of AHU connections.	50	[2]

Part 3 Execution

3.1 APPLICATION

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

3.2 INSULATION TERMINATION

- .1 Terminate insulation short of all control, smoke and fire dampers so as not to interfere with their operation.
- .2 Terminate insulation 900 mm [36"] short of duct mounted electric heating coils.

3.3 EXTERNAL FLEXIBLE INSULATION WITH VAPOUR BARRIER

- .1 Adhere insulation with insulation adhesive applied in 150 mm [6"] wide strips on 300 mm [12"] centres.
- .2 On rectangular ductwork and plenums, over 610mm [24"] in width, spotweld pins 6mm [1/4"] longer than the insulation thickness, one per square foot of duct minimum. If pins are installed in the field, a capacitor gun shall be used. Impale the insulation over the pins, and hold in place using metal or nylon clips (washers). Alternatively, use an assembly consisting of a welded pin with integral head washer welded in place over the insulation. (Clinched pins not acceptable).
- .3 Adhere foil faced vapour barrier tape over all butt joints, raw edges, holding washers and other points of penetration of the vapour barrier jacket on all exposed hot and cold ducts and concealed cold ducts.

3.4 INTERNAL FLEXIBLE DUCT LINER APPLICATION

- .1 Adhere insulation with insulation adhesive applied to the whole of the metal surface, with the coating side of insulation exposed to the airstream.
- .2 Ducts 610 mm [24"] in width and less require no further adhesion.
- .3 Ducts sides and plenum panels greater than 610 mm [24"] in width shall also have metal clips or nylon pins adhered to the metal surface at 300 mm [12"] to supplement the adhesive. (Welding pins may be used provided a capacitor type gun is used.) Impale insulation or the pins or clips, with the coated side of the insulation exposed to the airstream and secured with holding washers. Cover holding washers with reinforcing membrane and insulation coating / sealer.
- .4 Seal all transverse joints, raw edges, and other points of penetration of the coating with reinforcing membrane and insulation coating/sealer.

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

3.5 DUCTWORK INSULATION FINISHES

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

END OF SECTION

Part 1 General

1.1 RELATED WORK AND SECTIONS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
 - .1 Section 01 91 13 - General Commissioning Requirements
 - .2 Section 01 91 31 - Commissioning Plan
 - .3 Section 01 91 33 - Commissioning Forms
 - .4 Section 01 91 41 - Commissioning Training
 - .5 Section 23 05 00 - Common Work Results for HVAC
 - .6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
 - .7 Section 23 06 02 – Mechanical Forms
 - .8 Section 23 08 01 – Performance Verification

1.2 QUALITY ASSURANCE

- .1 CSA Standard Z320 -2011 Building Commissioning.
- .2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.
- .3 ASHRAE Guideline 1.1-2007 HVAC&R Technical Requirements for the Commissioning Process.

1.3 GENERAL

- .1 Be responsible for the performance and commissioning of all equipment supplied under the sections of Division 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.
- .2 In consultation with the Commissioning Manager (Prime Contractor), ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems. Coordinate mechanical commissioning activities with the Cx Manager to avoid redundancies and inefficiencies. The mechanical commissioning agent shall report to the Cx Manager and assist the Cx Manager with mechanical commissioning activities as they directly relate to the Cx Manager activities noted in Division 01 sections.
- .3 See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.
- .4 Collect all completed forms per section 23 06 02 Mechanical Forms as part the verification process.

1.4 COMMISSIONING AND DEMONSTRATION

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

- .2 Schedule: Submit a schedule, as part of the construction schedules, for the commissioning phase of the work. This schedule shall show:
 - .1 Equipment start-up schedule.
 - .2 Submission dates for the various documents required prior to substantial performance.
 - .3 Timing of the various phases of the commissioning, testing, balancing, and demonstration process.
- .3 Review: Within [2] weeks of commencing with the project work, the person having direct overall charge of mechanical Cx shall review design intent and intended commissioning procedures with the Cx Manager, Cx Authority, Consultant, and Departmental Representative. Six [6] weeks prior to the date of scheduled substantial performance, submit a detailed plan that addresses the entire approach to the commissioning process. The plan should be prepared specifically for the project at hand. The plan should include the following components:
 - .1 Name and qualifications of the commissioning agent.
 - .2 Itemized check lists for the readiness, start-up and operational verification of all equipment and systems.
 - .3 Outline of proposed method of notification and correction of interim operational deficiencies.
 - .4 Outline of proposed demonstration and operator training program.
- .4 Troubleshooting: Where problems become apparent during the commissioning process, work at the identification and resolution of these problems. The basic functions in trouble shooting are:
 - .1 What - Identification and definition of the problem.
 - .2 Why - Determination and evaluation of the causes.
 - .3 When - Determine the time available to resolve the problem.
 - .4 Involve the Cx Authority, Consultant, and Departmental Representative in the review of the problem and proposed resolution.
 - .5 Co-ordinate remedial action with the appropriate parties.
 - .6 Evaluate the effectiveness of the remedial action.

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

- .3 All deficiencies are to be recorded, reviewed by the commissioning team and, subsequently, corrected. The process at the point of the deficiency, shall be repeated before proceeding to PHASE 3.
- .2 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:
 - .1 Balancing of the air and liquid systems as specified in this section.
 - .2 Set up all automatic control valves/dampers and automatic temperature control devices.
 - .3 Plug all air pressure and flow measuring holes.
 - .4 Adjust vibration isolators and earthquake restraints as necessary.
 - .5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations.
 - .6 Verification of water tightness of all roof and exterior wall penetrations.
 - .7 Verification that all drain connections do not leak and are sloped.
 - .8 Testing and debugging of B.M.S. (Building Management System).
 - .9 Set up and test all alarm protective devices.
 - .10 Calibration and adjustment of the smoke venting and pressurization systems.
 - .11 Power failure test with emergency generator start-up.
 - .12 Submit Mechanical Forms per Section 23 06 02.
- .3 Fine Tuning
 - .1 Setting up automatic controls for accurate response and precise sequencing.
 - .2 Correction of problems revealed by Balance Agency and change of motor speed and pitch as necessary.
- .4 Testing
 - .1 A detailed check by a person having direct overall charge of commissioning. This check to include all items and functions to be later demonstrated to the Commissioning Authority, Consultant and Departmental Representative.

.3 PHASE 3 Verification of System Performance

.1 Verification of system performance by the Commissioning Authority will not commence until PHASE 2 has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:

- .1 The ease of access that has been provided throughout for servicing coils, motors, drives, fusible fire damper links, control and smoke dampers and damper operators.
- .2 Location of and opening and closing of all access panels.
- .3 Operability of randomly selected fire dampers.
- .4 Operation of all equipment and systems, under each mode of operation.
- .5 B.M.S. control features.
- .6 Automatic controls.
- .7 Rooftop AHUs and associated gas fuel systems.
- .8 Supply and Exhaust Fans
- .9 Split Air Conditioning Systems

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

- .1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.
- .2 A commissioning report which should include completed copies of all Phase 2 documentation outlined in the commissioning plan plus copies of start-up reports from specialty contractors and vendors and any other relevant information for inclusion in the operating & maintenance manuals.
- .3 B.C. Gas Inspection Dept. approval of AHU on gas firing.
- .4 Record drawings as specified, update to include changes resulting from commissioning.
- .5 A statement confirming completion of B.M.S. acceptance test, Section 23 09 01.
- .6 Collect all completed forms per section 23 06 02 Mechanical Form.

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 23 08 00 – Mechanical Commissioning
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 NATURAL GAS SYSTEMS

- .1 Operation tests:
 - .1 Measure gas pressure at gas meter outlet and at burner manifold.
 - .2 Verify details of temperature and pressure compensation at meter.
 - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
 - .4 Check terminals of vents for gas pressure regulators.

1.3 REPORTS

- .1 Provide TAB reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.4 TRAINING

- .1 Provide adequate time and resources to train the facility operators (4 personnel maximum, one time only) on the operation and maintenance of the following:
 - .1 AHU system operations, set-points and trending.
 - .2 System scheduling.
 - .3 Allow a minimum of 4 hours.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 SCOPE OF WORK

- .1 The new Air Handling Units shall be provided with their manufacturer's stand-alone AHU controls. However, all points as listed in Section 23 09 94 – Points List for HVAC Controls, as well as all points referenced in Section 23 09 93 – Controls Sequences shall be made available to the existing Building Automation System installed on the Penticton Air Terminal Building.
- .2 Controls contractor shall be responsible to perform all additions, updates, and modifications to the existing BAS system, including all logic, loops, and the graphic user interfaces to reflect the new equipment and perform the control sequences.
- .3 The new equipment controls shall be fully integrated with the existing BAS and the operator interface shall be through the existing operator's work station. The existing building automation system is supplied by Johnson Controls (JCI), and is BACnet capable. The operator station is located in the Mechanical room.

1.3 GENERAL

- .1 The control system is to be fully microprocessor based.
- .2 The controls system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the H.V.A.C. systems to perform properly in the manner described and as hereinafter specified.
- .3 The controls contractor shall furnish all materials, including all central computer hardware and software, operator input/output peripherals, standalone DDC panels, automation sensors and controls, wiring. The controls contractor shall be responsible for the design, installation, supervision and labour services, calibration, all software programming, and checkout necessary for a complete and fully operational Building Automation System.
- .4 The control system is to be set up and adjusted to achieve optimum operation of the H.V.A.C. system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will not be considered as extra to the Contract. These modifications to continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of the mechanical system.

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

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Shop drawings shall include:
 - .1 Control centre layouts.
 - .2 Manufacturer's descriptive technical literature for all equipment and devices.
 - .3 Interconnection schematics.
 - .4 Wiring and piping diagrams.
 - .5 One-line diagram from sensor and control points to Field Interface device and/or standalone DDC panel including all components and cables.
 - .6 Terminal cabinets, including termination listing.
 - .7 Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission. Sequences should reference English descriptors and labels for each point described.
 - .8 All input/output points which shall include the following information associated with each point.
 - .1 Sensing element type and location.

- .2 Details of associated field wiring schematics and schedules.
- .3 Software and programming details.
- .9 Detailed block diagrams of transmission trunk routing and configuration.
- .10 Valve and damper schedules indicating size, configuration, capacity and locations. If size varies greater than 10%, obtain approval of Departmental Representative.
- .11 Copies of all system graphics complete with system specific point labels.

1.5 WARRANTY

- .1 Refer to General Conditions.
- .2 The system including all hardware and software components shall be warranted for a period of one year following the date of final acceptance. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Departmental Representative.
- .3 All applicable software as detailed in this specification shall be updated by the Controls Contractor free of charge during the warranty period. This will ensure that all system software will be the most up-to-date software available from the Controls Contractor. All future patches to the software shall be made available to the Departmental Representative.
- .4 Repairs required by a total system failure, or the malfunction of any priority portion of the system shall be considered an emergency repair, and shall be performed within eight (8) hours of the report of the failure.
- .5 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Provide written assurance that a local service centre will be maintained with a complete stock of replacement parts, and capable of servicing any and all troubles in the system.
- .7 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .8 Take note of and provide any extended warranties specified.

Part 2 Materials

2.1 ELECTRICAL COMPONENTS, WIRING AND CONDUIT

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

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

- .6 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 Ft] intervals along the length. Identification bands to be sprayed on and not less than 100mm [4"] wide. Bands to be pink in colour unless in conflict with Division 26 colours.
- .7 Use colour coded conductors.
- .8 Adhere to all applicable electrical codes and regulations.
- .9 Obtain electrical permit.
- .10 For non-CSA equipment where required by electrical code, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.

2.2 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

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

Part 3 Execution

3.1 ALARMS - GENERAL

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

3.2 IDENTIFICATION

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

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

3.3 SYSTEM COMMISSIONING AND CALIBRATION

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

3.4 VERIFICATION OF SYSTEM COMMISSIONING

- .1 Preliminary Tests
 - .1 After installation of each part of the system and completion of mechanical and electrical hook-up, perform tests to confirm correct installation and functioning of equipment.
 - .2 Notify the Departmental Representative in writing at least seven days before testing is to take place stating the following:
 - .1 Location and part of system to be tested.
 - .2 Describe testing procedure and anticipated results.
 - .3 Provide all necessary testing equipment and personnel.
 - .4 Provide portable 2-way radios for communications during demonstrations. Provide three units on the same frequency and of sufficient power and quality as to be useful throughout the building.

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

3.5 MAINTENANCE SERVICE DURING THE WARRANTY PERIOD

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

- .3 Major Inspections: these inspections shall include but not be limited to the following:
 - .1 Work as detailed hereinafter for minor inspections.
 - .2 Clean all peripheral equipment, CPU, interface panels, multiplexing panels and microprocessor interior and exterior surfaces.
 - .3 Provide signal, voltage and system isolation checks of all CPU, interface panels, multiplexing panels and peripherals.
 - .4 Provide mechanical adjustments, new ribbons and necessary maintenance on printers.
 - .5 Check and/or calibrate each field input/output device.
 - .6 Run system software diagnostics as required.
- .4 Minor Inspections: These inspections shall include but not be limited to the following:
 - .1 Provide visual and operational checks to all CPU, peripheral equipment, interface panels, multiplexing panels, and field devices.
 - .2 Change filter and check fan for all CPU's peripheral equipment as required.
 - .3 Provide complete back up of BMS system.
 - .4 Regular service calls: these calls shall be performed during regular working hours, 8:00 a.m. to 4:30 p.m. Monday through Friday excluding legal holidays.
- .5 Emergency Service: the Departmental Representative will initiate service calls when there is indication that the control system is not functioning properly. The Contractor shall have qualified control personnel available during the warranty period to provide service to the "critical" control system components whenever required at no additional cost to the Departmental Representative. The Contractor shall furnish the Departmental Representative with a telephone number where the service mechanic can be reached at all times. The service mechanic shall be on the job ready to service the control system within the next eight (8) hours, after receiving a request for service and the work shall be performed continuously until the control system is back in reliable operating condition. Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Records and Logs: records and logs shall be kept of each maintenance task.
- .7 System Modifications: recommendations for system modification shall be provided in writing to the Departmental Representative. No system modification, including operating parameters and control settings, shall be made without prior approval.

- .8 Software: provide implementation of all software maintenance updates. These shall be accomplished as required and full coordination with control system supervisory personnel shall be maintained.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS:

- .1 Refer to Section 23 09 01 Controls General Requirements
- .2 Refer to Section 23 09 94 Controls Points List for HVAC

Part 2 Products

- .1 Refer to Section 23 09 01 Controls General Requirements

Part 3 Execution

3.1 HVAC CONTROL OBJECTIVES:

- .1 Program the system to meet the following objectives:
 - .1 Temperature:
 - .1 Control the temperature in each occupied space.
 - .2 Ventilation:
 - .1 Control the system's minimum outdoor air intake and supply to each zone to meet either minimum outside air flow rate or CO₂ levels as specified herein.
 - .3 Energy:
 - .1 Provide no more heating and cooling than is essential during Normal Operation.
 - .4 Operation:
 - .1 Systems shall remain under BMS control during all operating conditions (unoccupied mode, occupied mode)
 - .2 Integrate occupancy sensors with operation of AHU-4.
 - .3 Coordinate fire alarm reverification with Electrical subtrade.

3.2 MONITORING:

- .1 The BMS monitors the following conditions and parameters as a minimum:
 - .1 All damper positions
 - .2 Mixed air temperature
 - .3 Supply air temperature
 - .4 Outdoor air temperature and enthalpy
 - .5 Zone air temperature, enthalpy and CO₂ levels
 - .6 Zone occupancy (for NAVCAN equipment room)

- .7 Fan operation and status
- .8 Burner gas train operation and status
- .9 Compressor(s) operation and status
- .10 Differential pressure drop across the AHU filter sections

3.3 ALARMS AND SAFETIES:

- .1 When a smoke detector senses smoke, the associated AHU shall be shut-down and a smoke detection alarm shall be sent to the building's fire alarm panel.

3.4 EQUIPMENT AND SUBSYSTEMS CONTROL SEQUENCES:

- .1 New Air Handling Units AHU-2, AHU-4, AHU-5
 - .1 Components
 - .1 Air handling unit with packaged BACnet controller.
 - .2 Shut down
 - .1 Outdoor air and relief air dampers shall be closed.
 - .2 Fans, burners and cooling compressors shall be off.
 - .3 Normal operation
 - .1 The air handling units shall operate based on a fully programmable occupancy time schedule.
 - .2 The building control system shall provide an enable signal to the air handling unit packaged controller and shall monitor unit status.
 - .3 The building control system shall provide a supply air set point to the packaged controller. The packaged controller with the air handling unit shall control the operation of the cooling and heating system and economiser to achieve the required supply air temperature. The required supply air temperature shall be determined by the control system to maintain the room temperature set point.
 - .4 AHU-2, AHU5: backup gas heating shall activate as deemed necessary (low mixed air temperature).
 - .5 AHU-4: air handling shall activate for 60 minutes upon sensing occupancy, and/or when space temperature exceeds the setpoint range.
 - .4 Freeze Protection:
 - .1 A freeze protection controller with a 6 m sensing element supported downstream of the heating section shall cause the system to shut down upon sensing air temperature of 4°C or lower.
 - .2 Low temperature alarm to be monitored at BMS.

- .5 Smoke Detector and Fire Alarm Mode:
 - .1 When a duct smoke detector senses smoke, the associated unit shall be shut down and a smoke detection alarm shall be sent to the building Fire Alarm Panel.
- .2 New Supply Air Fans SF-1, SF-2
 - .1 Maintain existing sequence of operation.
 - .2 Components:
 - .1 Supply Fan
 - .2 Filter
 - .3 Thermostats
 - .3 Normal Operation:
 - .1 Supply fans shall run when the space temperature rises above the thermostat set-point; initially set to 25°C [77°F] adjustable.
- .3 New Exhaust Fans EF-1, EF-3
 - .1 Maintain existing sequence of operation.
 - .2 Components:
 - .1 Exhaust fan
 - .3 Shut down
 - .1 Fan is off.
 - .4 Normal Operation
 - .1 Fan shall run on scheduled operation.
 - .2 Open damper.
 - .3 When proven by end switch, start exhaust fan.
 - .4 Monitor fan status.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 GENERAL

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

1.3 DEVICE LEGEND

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

- .20 DTE = Damper Actuator Two Position Electronic
- .21 DMI = Damper Actuator Modulating Incremental Control
- .22 VME = Valve Actuator Modulating Electronic
- .23 VTE = Valve Actuator Two Position Electronic
- .24 VMI = Valve Actuator Modulating Incremental Control
- .25 MFT = VAV Box Flow Transmitter
- .26 FMS = Electronic Flow Measuring Station
- .27 WFS = Water Flow Measuring Station

1.4 **TABLE LEGEND**

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

1.5 **INPUT/OUTPUT POINTS LIST**

- .1 Provide full integration into the existing controls and connect to all new points.

1.6 **SYSTEM: ROOFTOP AHU WITH GAS HEATING (TYPICAL FOR AHU-02, AHU-05)**

- .1 Provide full integration of the AHU components to the existing BAS.

	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	OA-T Outdoor air temperature		X					OTS
	OA-D Outdoor air ctrl damper enable				X			DME
	OA-D Outdoor air ctrl damper status		X				FAIL	ESW
	MA-T Mixed air temperature		X				HI/LO	ATS
	MA-D Mixed air ctrl damper enable				X			DME
	MA-D Mixed air ctrl damper status		X				FAIL	ESW
	SA-T Supply air temperature		X				HI/LO	DTS
	SF- Supply air fan motor enable			X				ER
	SF- Supply air fan motor status	X					FAIL	CT
	Burner enable (modulating)				X			VME
	Burner status		X					ER

	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	Cooling enabled			X				
	Compressor(s) status (stage)	X					FAIL	
	Filters FF		X				DIRTY	DPT
	OA-enthalpy		X					
	Zone temperature sensor		X				H / L	RTS
	Zone temperature set-point adjust				X			
	Zone temperature override		X					
	Zone enthalpy		X					

1.7 **SYSTEM: ROOF TOP AHU WITHOUT GAS HEATING (AHU-04)**

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

	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	OA-T Outdoor air temperature		X					OTS
	OA-D Outdoor air ctrl damper enable				X			DME
	OA-D Outdoor air ctrl damper status		X				FAIL	ESW
	MA-T Mixed air temperature		X				HI/LO	ATS
	MA-D Mixed air ctrl damper enable				X			DME
	MA-D Mixed air ctrl damper status		X				FAIL	ESW
	SA-T Supply air temperature		X				HI/LO	DTS
	SF- Supply air fan motor enable			X				ER
	SF- Supply air fan motor status	X					FAIL	CT
	Cooling enabled			X				
	Compressor(s) status (stage)	X					FAIL	
	Filters FF		X				DIRTY	DPT
	OA-enthalpy		X					
	Zone temperature sensor		X				H / L	RTS

	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
	Zone temperature set-point adjust				X			
	Zone temperature override		X					
	Zone enthalpy		X					
	Zone occupancy		X					PIR/US

1.8 **SYSTEM: SUPPLY AIR FAN (TYPICAL FOR SF-1 AND SF-2)**

Unit No.	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
SF-1	Supply Fan status	X					FAIL	
SF1	Supply Fan enable			X				
Zone-T	Zone Temperature		X					
Zone-T-SP	Zone Temperature Set-Point				X			

1.9 **SYSTEM: EXHAUST AIR FAN (TYPICAL FOR EF-1 AND EF-3)**

Unit No.	Point Description	INPUT		OUTPUT		TUC	Alarm	Notes
		DI	AI	DO	AO			
EF-1	Exhaust Fan status	X					FAIL	
EF-3	Exhaust Fan enable			X				

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 19 - Waste Management and Disposal
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 23 05 00 – Common Work Results for HVAC
- .5 Section 23 08 01 - Performance Verification

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.18-01 (R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-01 (R2005), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B18.2.1-96 (R2005), Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1-15, Natural Gas and Propane Installation Code.

1.4 SUBMITTALS

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

- .2 Shop Drawings:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Indicate the following shop drawings:
 - .1 Valves and Valve Accessories
 - .2 Pressure reducing valves and regulators
 - .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: non-metallic flat.
- .4 Brazing: to ASTM B837.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.

- .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
- .3 Welding: butt-welding fittings.
- .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
- .5 Bolts and nuts: to ASME B18.2.1.
- .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

- .1 Provincial Code approved, lubricated plug type.
- .2 NPS 2 and under, screwed.
- .3 NPS 2-1/2 and over, flanged.
- .4 Suitable for the temperature to which exposed.
- .5 Certified by Canadian Gas Association (CGA).

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 PIPING

- .1 Install gas piping in accordance with CAN/CSA B149.1.
- .2 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly.
- .3 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.
- .4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .5 Slope piping down in direction of flow to low points.
- .6 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .7 Provide clearance for access for maintenance of equipment, valves and fittings.
- .8 Use dielectric type fittings where buried service enters and connects to building piping.

- .9 Joints:
 - .1 Gas service inside building - screw or weld NPS 2 and under. Weld NPS 2-1/2 and over.
 - .2 Gas service in ceiling plenums - weld all sizes.
 - .3 Gas service outside building - weld all sizes below ground.
- .10 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.
- .11 Paint all exposed and exterior gas piping – yellow.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by DFO Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.
- .3 Install valve on the main gas service entering the building. Valve to have locking lugs.

3.4 CONNECTIONS TO EQUIPMENT

- .1 Install unions or flanges in connections to all equipment and specialty components.
- .2 Arrange piping connections to allow ease of access and for removal of equipment.
- .3 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Notify the DFO Representative and the Inspection Authority having jurisdiction, 48 hours in advance of intended test date.
- .3 Examine piping for leaks. Remake all leaking connections and joints.
- .4 Submit final gas inspection certificate.
- .5 Performance Verification:
 - .1 Refer to Section 23 08 01 - Performance Verification.

3.6 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

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

3.7 CLEANING

- .1 Cleaning: in accordance with CAN/CSA B149.1, supplemented as specified.
- .2 Perform cleaning operations as specified in accordance with manufacturer's recommendations.
- .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 SUBMITTALS

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

1.3 REFERENCE STANDARDS

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

1.4 GENERAL

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

Part 2 Products

2.1 DUCTWORK - 500 PA [2" W.G.] STATIC PRESSURE

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

2.2 DUCTWORK – ACOUSTICALLY LINED

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

Part 3 Execution

3.1 DUCTWORK & PLENUM INSTALLATION

- .1 Where a duct contains a fire or smoke damper, construct the duct so that the free area of the duct is maintained through the fire or smoke damper.
- .2 Where a duct is to be internally insulated, enlarge the duct so as not to reduce the duct free area.
- .3 Make the taper of diverging transitions less than 20 deg. and the taper of converging transitions less than 30 deg., in accordance with Fig. 2-9 of the SMACNA Duct Standards. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.
- .4 Make the inside radius of any rectangular duct elbow at least equal to the duct width, measured in the direction of the radius. If space conditions do not permit a full radius elbow to be installed, use square elbows with multi-blade turning vanes.
- .5 Turning vanes shall be single wall type. Vanes in galvanized sheet metal ducts shall be constructed from galvanized steel, minimum thickness 0.76 mm [22 ga]. Vanes shall be spaced at 40 mm [1-1/2"] centres and shall turn through 90 deg., with a radius of 50 mm [2"]. Vanes shall not include a straight trailing edge. Refer to Figs. 2-3 and 2-4 of the SMACNA Duct Standards. Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 0.86 mm thick [18 ga].
- .6 For 500 Pa [2"] pressure systems, install tie rods to limit the maximum unsupported vane length to 914 mm [36"]. Refer to Fig. 2-4 of the SMACNA Duct Standards.
- .7 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs as required to suit site conditions.
- .8 Where indicated, install adjustable air turning devices, where full radius take-off fittings cannot be installed, in accordance with Fig. 2-16 of the SMACNA Duct Standards.

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

3.2 DUCTWORK AND PLENUM CLEANING

- .1 Responsibility
 - .1 This Contractor shall be responsible for and ensure that all ductwork, installed under this contract is internally CLEAN, when handed over to the Departmental Representative. This responsibility includes the entire new and existing systems, from outdoor air intakes to air terminals and from air terminals to relief outlets. It includes all ductwork, lined and unlined, all plenums and all equipment within or connected to ducts and plenums.
 - .2 The surfaces shall be considered clean when all foreign materials capable of particulating and visible to the naked eye are removed.

.2 Installation Procedure

- .1 All ductwork shall be wiped clean prior to installation.
- .2 Close all dampers immediately following installation thus checking the operation and retarding movement of contaminants through the system.
- .3 Seal all openings at the end of each day and at such other time as site conditions dictate.
- .4 Floor openings to be capped with sheet metal or floor grilles plus 0.15 mm [6 mils] thick poly sheet.
- .5 Other openings to be covered with 0.15 mm [6 mils] thick poly sheet taped so as to be airtight.

.3 Cleaning Procedure

- .1 On completion of the duct and plenum installation and prior to the installation of air terminals and prior to balancing of the air systems, but not until the areas are substantially clean (floors have been swept and vacuumed) and all "dirty" construction has been completed, employ an approved Cleaning Agency to vacuum clean the following:
 - .1 All plenums.
 - .2 All supply and return air ducts.
 - .3 All exhaust air ducts.
 - .4 Relief ducts.
 - .5 All outdoor air ducts.
- .2 All components within each system shall be thoroughly cleaned and shall include but not be limited to the following: coils, fans and motors, and air terminals.
- .3 After the duct systems have been cleaned they should be resealed if they are not being used. Provide filter media on the return air terminals if the return air fans are run after cleaning has been completed.
- .4 The Cleaning Agency shall perform a full inspection of the duct interior.
- .5 Spot checks will be made by the Departmental Representative during the cleaning process to verify that the required standard is being met. When substantial performance is claimed, final spot checks will be made to verify that the ducts are clean. If any ducts are found to be unclean, then they shall be re-cleaned.
- .6 Submit a report from the cleaning agency that certifies all specified air systems have been cleaned.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A480/A480M-12, Standard Specification for 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 for.
 - .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 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

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

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

2.2 SEALANT

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

2.3 DUCT LEAKAGE

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

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: Standard radius or short radius with single thickness turning vanes.

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

2.5 FIRE STOPPING

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

2.6 GALVANIZED STEEL

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

2.7 HANGERS AND SUPPORTS

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

- .3 Hangers: Galvanized steel angle with galvanized steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
- .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 EXAMINATION

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

3.2 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
.2 Angle hangers: complete with locking nuts and washers.
.3 Hanger spacing as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.4 SEALING AND TAPING

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

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 00 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 00 01 50 – General Instructions.
.3 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for sheetmetal duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 SUBMITTALS

- .1 Submittals: in accordance with the Submittal Procedure requirements in Section 01 33 00 – Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the PDF Operating and Maintenance and Commissioning Manuals.
- .3 Submit the following shop drawings:
 - .1 Duct Connectors
 - .2 Duct and plenum sealers
 - .3 Access doors in ducts and plenums.
 - .4 Instrument test ports.
 - .5 Spin-in Collars
- .4 Quality Control Check Sheets
- .5 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 – Closeout Submittals.

1.4 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .3 Quality Control Check Sheet:
 - .1 Prepare and maintain Quality Control Check Sheets.
 - .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.
 - .3 Check sheets to be filled in and submitted for review, prior to substantial completion.

- .4 Check sheets to include the following information:
 - .1 Ducts sealed all joints.
 - .2 Flexible connectors at all fan inlets, outlets and as shown.
 - .3 Wire mesh screens on all exhaust and intake locations
 - .4 Access doors at all listed locations and where shown.
- .5 For each tabulated item, state the following:
 - .1 Does the item comply with the specification? Yes/No/Not Applicable.
 - .2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

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

2.2 DUCT CONNECTORS – VIBRATION ISOLATION

- .1 Provide flexible duct connections to provide vibration isolation at all duct and plenum connections to fan and air handling units. See Figure 2-19 SMACNA Duct Standards.
- .2 Minimum Requirements:
 - .1 Pre-assembled 75 mm minimum long flexible connection with 75 mm long, 0.62 mm galvanized steel duct connectors on each side of the flexible connection. Flexible connector - fiber glass fabric with elastomer coating.
- .3 Centrifugal fans with 900 mm diameter and larger fan wheels, use 150 mm long flexible connection.

2.3 DUCTWORK AND PLENUM SEALERS

- .1 Provide duct sealing compounds for use in fabrication of all ductwork and plenum joints.
- .2 Low Pressure Systems - SMACNA Seal Classification B. Medium and High Pressure Systems - SMACNA Seal Classification A.
- .3 Where accessible, apply sealer to inside of joints on ducts and plenums under positive pressure - e.g. on the discharge side of fans.
- .4 Apply sealer to outside of joints on ducts and plenums under negative pressure - e.g. on the suction side of fans.

2.4 SEALANT AND TAPE

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.
- .2 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.5 ACCESS DOORS IN DUCTS AND PLENUMS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.6 INSTRUMENT TEST PORTS

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.7 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to correspond with round duct standards.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 DUCT CONNECTORS – VIBRATION ISOLATION

- .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .6 Ensure flexible duct connectors do not reduce duct free area on suction side of fans.

3.3 SEALING AND TAPING

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

3.4 DUCT AND PLENUM ACCESS

- .1 Locations: Provide access doors and panels as follows:
 - .1 Doors: where shown on the drawings.
 - .2 Panels:
 - .1 Every 12 m on all ductwork.
 - .2 At the base of each duct riser.
 - .3 Both sides of equipment blocking the duct e.g.
 - .1 Air flow measuring stations
 - .2 Coils

- .4 At or to one side of other equipment in duct e.g.
 - .1 Backdraft dampers (counter weight side)
 - .2 Balance dampers serving multiple outlets/inlets
 - .3 Bearings (fans/motors)
 - .4 Control/operating dampers
 - .5 Control sensors
 - .6 Fire dampers (rectangular ducts and round ducts 330 mm dia. and larger - latch side)
 - .7 Heat detectors (upstream from device)
 - .8 Smoke detectors (upstream from device)
- .5 Panels need not be provided where access is available through a door or a register mounted on the side of the duct.
- .3 Patches:
 - .1 Where required for cleaning and where access panels are not specified, e.g. on both sides of turning vanes.
 - .4 Flexible duct - on round duct and round fire dampers up to 300 mm dia.
- .2 Seal frames airtight.
- .3 Install so as not to interfere with airflow.
- .4 Install to provide easiest possible access for service and cleaning.
- .5 Do not use sheet metal screws for attaching access panels to ductwork.
- .6 Round ducts 330 mm dia. and larger shall include a short collar for the installation of access panels.
- .7 Small rectangular ducts shall be transitioned to a minimum dimension across the duct of 330 mm for the installation of access panels.
- .8 Provide retaining chains on panels 2.1 m above floor, and higher.

3.5 INSTRUMENT TEST PORTS

- .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.

- .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.

3.6 SPIN-IN COLLARS

- .1 Provide spin-in collar and balancing damper for all round duct takeoffs from a main duct.

3.7 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Balancing dampers for sheet metal ventilation and air conditioning systems.
- .2 Provide balancing dampers for each new air terminal device, and branch duct.

1.2 RELATED SECTIONS

- .1 Not used.

1.3 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2005.

1.4 SUBMITTALS

- .1 Submittals: In accordance with the Submittal Procedure requirements in Section 01 33 00 – Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the PDF Operating and Maintenance and Commissioning Manuals.
- .3 Shop Drawings:
 - .1 Include the following shop drawings:
 - .1 Balancing dampers
- .4 Quality Control Check Sheets.
- .5 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 – Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

1.6 WASTE MANAGEMENT AND DISPOSAL:

- .1 Per Section 01 74 19 – Waste Management and Disposal.

1.7 QUALITY CONTROL

- .1 General:
 - .1 Quality Control Check Sheet:
 - .1 Prepare and maintain Quality Control Check Sheets.
 - .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.
 - .3 Check sheets to be filled in and submitted for review, prior to substantial completion.

- .4 Check sheets include the following information:
 - .1 Dampers as specified.
 - .2 Ensure dampers installed in all duct branches.
 - .3 Dampers to be vibration and noise free.
 - .4 Damper operators to be accessible.
 - .5 No binding within duct.
 - .6 Check tape installed by balancing contractor.
 - .7 For each tabulated item, state the following:
 - .1 Does the item comply with the specification?
Yes/No/Not Applicable.
 - .2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 BALANCING DAMPERS

- .1 Construction in accordance with SMACNA Duct Standards - Figs. 2-14 and 2-15.
- .2 Minimum Requirements:
 - .1 Rectangular ducts:
 - .1 Up to 300 mm deep - single blade (butterfly type).
 - .2 330 mm to 400 mm deep - two opposed blades, mechanically interlocked with pivots at quarter points.
 - .3 430 mm deep and over - multiple opposed blades, mechanically interlocked with blades not greater than 200 mm deep and pivots equally spaced.
 - .2 Round Ducts:
 - .1 Single blade (butterfly type).
 - .3 Material:
 - .1 Minimum 1.47 mm thick galvanized steel blade on all butterfly dampers (V-groove stiffened), 300mm and smaller.
 - .2 Use heavier industrial grade single blade balancing damper on ducts larger than 300mm diameter.

- .3 Minimum 1.47 mm thick galvanized steel blades on multi-blade dampers with rigidly constructed galvanized steel frame (no frame required on single blade dampers). Factory manufactured.
- .4 Minimum 1.14 mm thick stainless steel blades for industrial exhaust ducts.
- .4 Bearings:
 - .1 End bearings on all low pressure single blade dampers above 300 mm dia.
 - .2 Inside and outside nylon end bearings for single blade dampers.
 - .3 Bearings on multiple blade dampers shall be bronze self-lubricating type.
- .5 Operating Mechanism:
 - .1 Lockable quadrant type with end bearing on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.
 - .2 Shaft extension to accommodate insulation thickness.
 - .3 Wide pitch screw mechanism type with crank operator on accessible rectangular ducts 430 mm and over in depth and on inaccessible rectangular and round ducts.
 - .4 Override limiting stops.
 - .5 No blade movement in set position.

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 and in each branch duct, for supply, return and exhaust systems.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Runouts to registers, grilles and diffusers: install single blade damper located as close as possible to main ducts, where branches are taken from larger duct, as required for proper air balancing.
- .4 Dampers: vibration free.
- .5 Ensure damper operators are observable and accessible.

- .6 Identify the airflow direction and blade rotation and open and closed position.
- .7 On all round ductwork larger than 300 mm diameter and on externally insulated rectangular ductwork, provide sheet metal bridge to raise quadrant type operators above the insulation thickness. Provide an open end bearing where bridges are used. Bridges on uninsulated round ducts shall be at least 25 mm high.
- .8 Where quadrant type operators are used, the lever shall be arranged parallel with the damper blade.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of flexible ductwork, joints and accessories.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-05, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
- .4 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.3 SUBMITTALS

- .1 Submittals: In accordance with the Submittal Procedure requirements in Section 01 33 00 – Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format.
- .3 Submit shop drawings for flexible ducts. Include the following information:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Leakage.
 - .4 Fire rating.
- .4 Quality Control Check Sheets.
- .5 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00 – Closeout Submittals.

1.4 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.

- .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet.
 - .2 Check sheets to include the following information:
 - .1 Ducts installed as shown or as required to accommodate duct offsets.
 - .2 Duct free area maintained along complete length.
 - .3 Supports.
 - .4 Duct joints.
 - .3 For each tabulated item, state the following:
 - .1 Does the item comply with the specification? Yes/No/Not Applicable.
 - .2 Identify any areas of non-compliance and the proposed action to make it compliant.

Part 2 Products

2.1 DUCTWORK – FLEXIBLE

- .1 Minimum Requirements:
 - .1 Non-corrosive spiral wire reinforcing with flexible vinyl coated fiberglass cloth membrane.
 - .2 Suitable for up to 2500 Pa positive static pressure and 250 Pa negative static pressure.
 - .3 U.L. or U.L.C. labelled, Class 1, duct connector.
 - .4 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.
 - .5 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

Part 3 Execution

3.1 DUCTWORK– FLEXIBLE

- .1 Installed lengths shall be limited to 4 times duct diameter but not longer than 1200 mm.
- .2 Connect to ductwork and diffusers with stainless steel worm drive clamps or PVC duct strap applied over two wraps of duct tape. Use stainless steel clamps on connections to fire dampers.

- .3 Minimum centreline radius of flexible ductwork bends shall be 1.5 times the duct diameter, alternatively, sheet metal elbows may be used at branch takeoffs and boot/diffuser connections.
- .4 Support with 25 mm x 0.76 mm galvanized steel straps at a maximum of 600mm. Straps shall completely encircle duct.
- .5 Support clear of ceiling assembly, light fixtures and hot surfaces.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 23 05 00 – Common Work Results for Mechanical
- .3 Section 23 05 48 – Vibration and Seismic Controls
- .4 Section 23 33 00 – Air Duct Accessories

1.2 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit dimensional drawings
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, power (kW) and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.

- .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, power (W), efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

2.2 FANS GENERAL

- .1 Motors:
 - .1 Sizes as specified.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet safety screens inlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3 CABINET FANS - GENERAL PURPOSE

- .1 Fan wheels:
 - .1 Welded steel construction.
 - .2 Maximum operating speed of fans not more than 50% of first critical speed.
 - .3 Backward inclined blades, as indicated.
- .2 Bearings: grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.
- .3 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide latched airtight access doors with handles.
- .4 Casing floor mounted single or multiple wheel in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard inside casing.
- .5 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to MPI #18. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented, complete with metal nosings on exposed edges.

2.4 EXHAUST FAN EF-1, EF-3

- .1 Downblast fan shall be for roof mounted applications.
- .2 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.
- .3 Constructed of aluminum.
- .4 Non-overloading, backward inclined centrifugal.
- .5 Statically and dynamically balanced in accordance to AMCA Standard 204-05.
- .6 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
- .7 Motor shall be Electronically Commutated Motor (ECM), direct drive
 - .1 Motor enclosures: Open type
 - .2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.

- .3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
- .4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
- .5 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
- .6 Motor shall be a minimum of 85% efficient at all speeds.
- .8 Housing:
 - .1 Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
 - .2 Shroud shall have an integral rolled bead for extra strength
 - .3 Shroud shall be drawn from a disc and direct air downward
 - .4 Lower windband shall have a formed edge for added strength
 - .5 Motor cover shall be drawn from a disc
 - .6 All housing components shall have final thicknesses equal to or greater than preformed thickness.
 - .7 Curb cap shall have pre-punched mounting holes to ensure correct attachment
 - .8 Rigid internal support structure
 - .9 Leak proof
- .9 Housing Supports and Drive Frame:
 - .1 Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators
- .10 Roof Curb Adaptor:
 - .1 Custom size, connect to existing roof curb.
 - .2 Galvanized, rubber seal between fan and roof curb adaptor.
- .11 Hinge Kit:
 - .1 Aluminum hinges
 - .2 Allows the fan to tilt away for access to wheel and ductwork for inspection and cleaning
- .12 Hinge Base:
 - .1 Aluminum hinges
 - .2 Hinges and restraint cables are mounted to a base (sleeve)
 - .3 Allows the fan to tilt away for access to wheel and ductwork for inspection and cleaning

- .13 Tie-Down Points:
 - .1 Four heavy gauge aluminum brackets to secure the fan in heavy wind applications
- .14 Disconnect Switches:
 - .1 Supplied by electrical trade.
 - .2 Wired from fan motor to junction box installed within motor compartment.

2.5 SUPPLY FAN SF-1, SF-2

- .1 Side intake filtered supply fan.
- .2 Filters designed with large surface area for efficient filtration.
- .3 Green weather resistant baked powder coat finish.
- .4 Weather proof cabinet designed for outdoor roof mounting.
- .5 Flexible forward curved belt drive blowers operate at low speed and low noise levels.
- .6 Heavy duty ball bearings.
- .7 Latched top cover.
- .8 Motor shall be Electronically Commutated Motor (ECM), direct drive,
 - .1 Motor enclosures: Open type
 - .2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.
 - .3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
 - .4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
 - .5 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 - .6 Motor shall be a minimum of 85% efficient at all speeds.
- .9 Housing Supports and Drive Frame:
 - .1 Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators
- .10 Roof curb: seismic rated.
- .11 Tie-Down Points:
 - .1 Four heavy gauge aluminum brackets to secure the fan in heavy wind applications

- .12 Disconnect Switches:
 - .1 Supplied by Electrical trade.
 - .2 Wired from fan motor to junction box installed within motor compartment.
- .13 Supply Fan SF-2: Provide custom gravity hood assembly mounted below fan SF-2, c/w bird screen and louvre. See site photos on drawing M003. Match configuration to existing.

Part 3 Execution

3.1 EXAMINATION

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

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .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 01 74 19 - Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with 01 74 19 - Waste Management and Disposal.

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of supply, return and exhaust grilles, registers and diffusers.

1.2 SYSTEM DESCRIPTION

- .1 Performance Requirements: Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

- .1 Submittals: In accordance with the Submittal Procedure requirements in Section 01 33 00 – Submittal Procedures.
- .2 Submit all information and data in both printed paper format and PDF electronic format.
 - .1 Submit the following shop drawings:
 - .1 Diffusers
 - .2 Grilles and registers
 - .2 Include product characteristics, performance criteria, and limitations.
 - .3 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
- .3 Quality Control Check Sheets.
- .4 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00

1.4 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Checks:
 - .1 Prepare and maintain Quality Control Check Sheets.
 - .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

- .3 Check sheets to be filled in and submitted for review, prior to substantial completion.
- .4 Check sheets to include the following information:
 - .1 Diffuser/grille/register type
 - .2 Material
 - .3 Colour
 - .4 Balance damper in duct branch or integral to register
 - .5 Seismic restraint
 - .6 Noise level
 - .7 Correct installation height for volume and throw
 - .8 Standard of installation
- .5 For each tabulated item, state the following:
 - .1 Does the item comply with the specification? Yes/No/Not Applicable.
 - .2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated on drawing equipment schedules.
- .2 Concealed manual volume control damper operators, as scheduled.
- .3 Colour: as scheduled.
- .4 Base air outlet application on space noise level of NC 30 maximum.
- .5 All air terminals must be checked for compatibility with ceiling types. Refer to Architectural reflected ceiling plans.
- .6 All ceiling mounted air terminals shall be provided with means for attachment of two seismic security wires at opposite corners of each air terminal.
- .7 Ceiling tee-bar modules are in soft conversion metric, SI metric measurements, unless where specifically noted otherwise.
- .8 The manufacturer (other than the design listed) shall match performance data and indicate a specific comparison for each item, with the shop drawing submission.
- .9 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.2 SUPPLY GRILLES AND REGISTERS

- .1 Refer to equipment schedules on drawings for sizes and air quantities.

2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 Refer to equipment schedules on drawings for sizes and air quantities.
- .2 Exhaust Grille E-1
 - .1 The egg crate grille shall be supplied with a cubical grid core, used as a high capacity return or exhaust outlet with high free area and low sound and pressure drop.
 - .2 Grilles shall be aluminum construction, consisting of an extruded aluminum border and an aluminum 13x 13 x13 mm egg crate core.
 - .3 All components shall have a baked-on powder coat finish.
 - .4 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
 - .5 The paint film thickness shall be a minimum of 2.0 mils.
 - .6 The finish shall have a hardness of 2H.
 - .7 The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers, unless shown otherwise.
- .4 Refer to Architectural Reflected Ceiling plans for exact locations of air terminals.
- .5 Paint ductwork behind grilles with matte black paint where duct or insulation surfaces are visible.
- .6 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.

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

3.2 CLEANING

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

END OF SECTION

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 not acceptable refrigerants for any new installations.
- .5 Document **all** work on Halocarbon Systems using PWGSC halocarbon forms. 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 General

1.1 REFERENCES

- .1 American Gas Association (AGA)
- .2 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
 - .1 ANSI/AHRI 210/240-[08], Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - .2 ANSI/AHRI 270-[08], Sound Rating of Outdoor Unitary Equipment.
- .3 CSA Group
 - .1 CSA B52-[05], Mechanical Refrigeration Code.
 - .2 CSA C22.1-[12], Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Underwriters Laboratories (UL)
 - .1 UL 1995-[11], Standard for Heating and Cooling Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [outdoor HVAC equipment] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
 - .2 Drawings to indicate project layout and dimensions; indicate:
 - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
 - .2 Piping, valves, fitting shipped loose showing final location in assembly.
 - .3 Control equipment shipped loose, showing final location in assembly.

- .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
 - .6 Pump and fan performance curves.
 - .7 Details of vibration isolation.
 - .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
 - .9 Type of refrigerant used.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .6 Manufacturer's Field Reports:
 - .1 Submit manufacturer's field reports specified.
 - .2 Construction Waste Management:
 - .1 Specified in Section 01 74 19 – Waste Management and Disposal.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
 - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store and protect outdoor HVAC equipment from nicks, scratches, and blemishes.
 - .2 Replace defective or damaged materials with new.

1.5 WARRANTY

- .1 For Work of this Section 23 74 00 - Packaged Outdoor HVAC Equipment, 12 months warranty period is extended to 24 months.

Part 2 Products

2.1 AIR HANDLING UNITS AHU-2, AHU-4, AHU-5

- .1 Unit(s) furnished and installed shall be Heat pump packaged rooftop as per mechanical schedule and specified herein. Cooling capacity ratings shall be based on AHRI Standard. Units shall consist of insulated weather-tight casing with compressors, air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit packaged controls (BACnet).
- .2 Units shall be 100% factory run tested and fully charged with R-410A
- .3 Units shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- .4 Units shall be convertible airflow design as manufactured.
- .5 Wiring internal to the unit shall be colored and numbered for identification.
- .6 Unit Casing:
 - .1 Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.
 - .2 Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.
 - .3 Cabinet construction shall allow for all service/ maintenance from one side of the unit.
 - .4 Cabinet top cover shall be one piece construction or where seams exists, it shall be double-hemmed and gasket-sealed.
 - .5 Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
 - .6 Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

- .7 Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
- .8 Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.
- .9 The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.
- .7 Air filters
 - .1 Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. 50mm thick glass fiber disposable media filters shall be provided with the provisions within the unit.
 - .2 Provide spare 50mm thick filters to be field-installed.
- .8 Fans and Motors
 - .1 Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
 - .2 Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
 - .3 Provide units direct drive, multiple speed, dynamically balanced supply fans.
 - .4 Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.
 - .5 Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
 - .6 Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- .9 Gas Heating Section
 - .1 AHU-2, AHU-5: Provide backup gas burner, factory installed and tested.
 - .2 Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping.
 - .3 Heating section shall be factory run tested prior to shipment.
 - .4 Induced draft combustion type with direct spark ignition system, redundant main gas valve, and 2-staged heat.

- .5 Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Provide flame rollout switches.
- .6 Induced draft blower shall have combustion air proving switches and built-in thermal overload protection on fan motor.
- .7 Heat Exchanger: Provide tubular section type constructed from 18-gauge aluminized steel.
- .8 Burners: Burners shall be of the in-shot type constructed of stainless steel.
- .9 Limit controls: High temperature limit controls will shut-off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.
- .10 Evaporator Coil
 - .1 Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
 - .2 Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.
 - .3 Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.
- .11 Condenser Section
 - .1 Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.
- .12 Refrigeration System
- .13 AHU-4: Compressor (3 ton): Provide direct-drive hermetic, reciprocating type compressor(s) with centrifugal oil pump providing positive lubrication to moving parts and automotive type pistons, rings to prevent gas leakage, internal suction and discharge valves and crankcase heater. Motor shall be suction gas-cooled with internal temperature and current sensitive motor overloads. Internally isolated motors on springs.
- .14 AHU-2, AHU-5: Compressor (5 ton): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.
- .15 Units shall have cooling capabilities down to 0 degree F as standard For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.
- .16 Provide each unit with refrigerant factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

- .17 For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.
- .18 Outdoor Air Section
 - .1 Provide economizer with dry bulb control
 - .2 Provide adjustable minimum position control located in the economizer section of the unit.
 - .3 Provide spring return motor for outside air damper closure during unit shutdown or power interruption.
- .19 Operating Controls
 - .1 Provide packaged microprocessor unit-mounted DDC control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling, and ventilating decisions through resident software logic.
 - .2 Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.
 - .3 Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.
 - .4 Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.
 - .5 Provide low-ambient kit.
 - .6 BACnet compatible, for connection to existing building automation system.
- .20 Staging Controls
 - .1 Provide NEC Class II, electronic, adjustable zone control to maintain zone temperature setting.
 - .2 Provide manual changeover control with (heat-off-cool) temperature controls and fan auto/on switch.
- .21 Roof Curb
 - .1 Contractor shall provide factory supplied seismic roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
 - .2 Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

- .3 Seismic rated.

2.2 CONTROLS

- .1 As indicated in Section 23 09 01 – Controls General.
- .2 BACnet compatible, connect to existing building automation system.

2.3 CAPACITY

- .1 As indicated on Equipment Schedule

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 outdoor HVAC 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.
- .2 Contractor shall verify that roof is ready to receive work and opening dimensions are as specified
- .3 Contractor shall verify that proper power supply is available.

3.2 INSTALLATION

- .1 Install as per manufacturers' instructions on roof curbs provided by manufacturer.
- .2 Manufacturer's representative to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge over roof drain.
- .4 Contractor shall install in accordance with manufacturer's instructions.
- .5 Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.
 - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

3.4 DEMONSTRATION

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

3.5 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Perform cleaning operations in accordance with manufacturer's recommendations.
- .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS & SUMMARY

- .1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01. This project involves new wiring to rooftop receptacles which will require new roof penetrations, reusing existing wiring to rooftop equipment being replaced, new breakers and local disconnects for this equipment. Refer to drawings for details.
- .2 Reference to “Electrical Divisions” shall mean all sections of Division 26 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .5 The most stringent requirements of this and other electrical sections shall govern.
- .6 All work shall be in accordance with the project Drawings and Specifications and their intent complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment and wiring systems, if applicable.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.
- .9 Coordinate electrical commissioning scope with the Commissioning Manager (prime contractor) and the Commissioning Authority. Participate in commissioning activities as a proactive member of the project commissioning team. See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.

1.2 REFERENCES

- .1 Install in accordance with CSA C22.1 (current adopted edition).
- .2 Refer to CSA C22.1 Appendix A “Safety Standards for Electrical Equipment” for applicable codes and the related revisions

- .3 Refer to CSA C22.1 Pages xxix - xxxii for related 'Reference Publications'
- .4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.
- .5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.
- .6 CSA Standard Z320 -2011 Building Commissioning

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

- .1 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

- .1 Submittals to be in accordance with Division 01.
- .2 Product Data: submit WHMIS MSDS in accordance with Division 01 and Division 02.
- .3 Shop Drawings:
 - .1 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
 - .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
 - .3 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
 - .4 Content
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Information shall include all scheduled data.
 - .5 Advertising literature will be rejected.
 - .6 The project and equipment designations shall be identified on each document.
 - .7 Information shall be given in metric units.

- .8 The shop drawings/product data shall include:
 - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.
 - .2 Mounting arrangements.
 - .3 Detailed drawings of bases, supports and anchor bolts.
 - .4 Control explanation and internal wiring diagrams for packaged equipment.
 - .5 A written description of control sequences relating to the schematic diagrams.
- .4 Format
 - .1 PDF submitted via e-mail.
 - .2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.
- .5 Coordination
 - .1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.
- .6 Keep one [1] copy of shop drawings and product data, on site, available for reference.
- .7 Quality Control: in accordance with Division 01 - Quality Control
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Submit, upon completion of Work, the electrical "load balance" report.
- .8 Permits and Fees:
 - .1 Submit to Electrical Inspection Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.
 - .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Division 01.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings: in accordance with Section 00 01 50 General Instructions.
 - .1 Site Meetings: as part of Manufacturer's Field Services: schedule site visits, to review Work, at stages listed below:
 - .1 During progress of Work at key schedule points as determined and coordinated with mechanical trade.
 - .2 At commissioning.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .2 Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 Waste Management and Disposal.

1.8 SYSTEM START-UP

- .1 Refer to Section 00 01 50 General Instructions, and as follows.
- .2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.11 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 Where imperial units have been indicated in brackets [] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.12 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Departmental Representative, 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 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.13 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.

1.14 REUSED EQUIPMENT

- .1 Where existing equipment is being relocated and re-used, check and report on the condition to the Departmental Representative before reinstallation. Protect and carefully store equipment designated for reuse.

1.15 SEQUENCE OF WORK

- .1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.
- .2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- .3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.

- .4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.16 BUILDING OPERATION DURING CONSTRUCTION

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

1.17 EXISTING SERVICES

- .1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative staff to trace the originating source and points served. Obtain instructions from the Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative approval of the timing, and work to minimize any interruptions.
- .3 Shutdowns, to permit connections, to be coordinated with the maintenance staff.
- .4 In order to maintain existing services in operation, temporary relocations and wiring may be required.
- .5 Be responsible for any damages to existing systems by this work.
- .6 The interruption of utility services to permit tie-ins shall be arranged through the Departmental Representative. Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown. Service shutdowns shall only be carried out by Physical Plant and will normally be scheduled to occur during evenings or weekends. The Departmental Representative reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting-off of a service interferes with essential building operations.

1.18 SALVAGE

- .1 All conduit, wiring and equipment which becomes redundant and is no longer required due to the work in this Contract shall be completely removed.

- .2 All existing items which need to be removed, and which have a reasonable salvage value, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.
- .3 Remove all redundant material not required by the Departmental Representative from the site.

1.19 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.
- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.20 TENDER INQUIRIES

- .1 All contractor queries during the tender period shall be made in writing to the Departmental Representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental Representative's office during tender. All tender queries may be faxed, mailed or couriered to the Departmental Representative's office. No telephone questions will be answered.

1.21 EXAMINATION

- .1 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.22 RESPONSIBILITIES

- .1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.

- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.
- .5 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.
- .6 Refinish damaged or marred factory finish to factory finish.
- .7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.23 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

- .1 Submit price breakdowns ten (10) days after the award of contract,
- .2 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Departmental Representative. Provide details for each section of the electrical work listed for each separate electrical change order item.
- .3 Mark-up information is required for change orders but is optional on the original tender price.
- .4 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

1.24 PROJECT CLOSE-OUT REQUIREMENTS

- .1 Refer to detailed specifications in each section for detailed requirements. Record drawings to be submitted to Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative.

1.25 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
 - .1 Commission all systems and prove out all components, interlocks and safety devices.

- .2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.
- .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Operating and Maintenance Manuals completed.
 - .3 "As Built" Record Drawing ready for review.
 - .4 Systems Commissioning has been completed and has been verified by Departmental Representative.
 - .5 All demonstrations to the Departmental Representative have been completed.
- .3 Departmental Representative's Letters of Assurance will not be issued until the following requirements have been met:
 - .1 All items listed in .1 above have been completed or addressed.
 - .2 Certificate of Penetrations through separations.
 - .3 Provincial or City Electrical Inspection - Certificate of inspection.
 - .4 Seismic Engineer's letter of Assurance and final inspection report (As required).
 - .5 Certificate of Substantial Performance.
 - .6 Signed off copy of Departmental Representative's final inspection report.
 - .7 Fire alarm verification.

1.26 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26 (electrical) work have been met and verified.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01 and as follows.

- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.
- .3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified. Refer to mechanical equipment list for details specific to this project.
- .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.

2.3 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify all electrical equipment including but not limited to starters, disconnects, and controls with nameplates and labels as follows:
- .2 Nameplates:
 - .1 Lamicoid 3 mm [0.125"] thick plastic engraving sheet, white face, black core, self-adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.
 - .2 Nameplate Sizes:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .3 Typical Labelling:
 - .1 Panelboard & CDP – 5 lines
 - .1 Line 1 – Panel/CDP designation – Size 4 lettering
 - .2 Line 2 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering
 - .3 Line 3 – Feeder: eg 4#3 – 35mm C – Size 2 lettering
 - .4 Line 4 – Origin eg: Main Elect. Room – Size 2 lettering
 - .2 Distribution Circuit Breakers – 4 lines
 - .1 Line 1 – Main Circuit Breaker – Size 4 lettering
 - .2 Line 2 – Feeder: eg 4#3 – Size 2 lettering
 - .3 Line 3 – Origin: eg K1 Sub-station – Size 2 lettering
 - .3 Label colours unless otherwise indicated:
 - .1 120/208V labels: white letters on black base.
 - .2 347/600V labels: Black letters on white base.
 - .4 Wording on nameplates to be approved prior to manufacture.
 - .5 Allow for average of twenty-five (25) letters per nameplate.
 - .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .7 Terminal cabinets and pull boxes: indicate system and voltage.
 - .8 Transformers: indicate capacity, primary and secondary voltages.
- .3 Labels:
 - .1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Departmental Representative before installing. Circuit numbers to agree with Record Drawings.
 - .4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.

- .3 Colour code: to CSA C22.1.

2.6 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.
.2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.
.3 Colour coding to be as follows unless otherwise specified:

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
347/600V Normal	Dark Blue		
120/208V Normal	Light Blue		
Ground	Dark Green		GR
Fire Alarm	Red		FA
Emg Voice Paging	Red	Dark Green	EP
Computer/Data	Light Green		COM
Telephone	Light Green	Black	TEL
General Intercom	Light Green	Yellow	IC
Low Level Paging	Light Green	White	PA
Building Alarm	Purple	White	BA
BAS (Digital)	White	Green	BCD
BAS (110V)	White	Black	BCH
BAS (LV)	White	Blue	BCL
PLC (Digital)	White	Brown	PLC
Low Voltage Control	White	Yellow	LVC

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.
.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.
.3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.
.4 Paint outdoor electrical equipment "equipment green" finish.
.5 Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

2.8 ANCHOR BOLTS AND TEMPLATES

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

2.9 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa [2000 psi] [refer to structural drawings].
 - .2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 Cast-in-place type:
 - .1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel, or equivalent.
 - .2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm [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, or equivalent 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, or equivalent stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Hilti HDI or UCAN IPA, or equivalent drop-in anchor for concrete.
 - .4 Hilti or UCAN Sleeve Anchor, or equivalent. (medium and light duty) for concrete and masonry.
 - .5 Hilti ZBP or UCAN Zamac, or equivalent pin bolt (light duty) for concrete and masonry.
 - .3 Drilled, adhesive type:
 - .1 Hilti HVA or UCAN, or equivalent Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Hilti HY150 or equivalent consisting of anchor rod with a 2 part adhesive system.

- .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
- .4 Rod assemblies shall extend a minimum of 50 mm [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; or equivalent.

2.10 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Support ceiling hung equipment with rod hangers and/or structural steel.

2.11 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
 - .1 Support of equipment.
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
 - .3 Earthquake restraint devices - refer also to "Seismic Restraint" sections
 - .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be primed and undercoat painted ready for finish under the related Division.

2.12 MAINTENANCE MATERIALS AND CABINET

- .1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.

2.13 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.

- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .3 Include in the manual the following major sections:
 - .1 Title page (in plastic cover).
 - .2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.
 - .3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.
 - .4 Local source of supply for each item of equipment.
 - .5 Wiring and control diagrams.
- .4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm [2"] rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Departmental Representative before printing.
- .5 Submit a draft copy to the Departmental Representative for review thirty (30) days prior to start up of the systems and equipment.
- .6 Submit three (3) copies in the final approved form.

2.14 PROJECT RECORD DRAWINGS

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.
- .2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Departmental Representative on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.

- .3 At the time of "substantial performance" CAD files will be provided by the Departmental Representative. The Electrical Division shall include all associated costs to obtain and complete the CAD Record Drawings including retaining the services of an approved CAD draftsman to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.
- .4 Submit the "Record Drawing" CAD files and one set of plots to the Departmental Representative prior to Total Performance of the contract.
- .5 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm [2"].
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.
- .4 All cables and conduits to be installed concealed in finished areas.

3.4 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system.

3.5 FIELD QUALITY CONTROL

- .1 Load and Balance:
 - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

- .2 Conduct and pay for the following tests:
 - .1 Circuits originating from branch distribution panels.
 - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .3 Systems: fire alarm system for all affected devices.
 - .4 Main ground resistance (at all grounding locations).
 - .5 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Reports:
 - .1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.6 CLEANING

- .1 Do final cleaning in accordance with Division 01.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

3.7 WORKMANSHIP

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

3.8 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.9 PROTECTION OF ELECTRICAL EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.10 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.11 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.
- .2 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.
- .3 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.
- .4 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.
- .5 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be repenetrated.

- .6 Allow openings for 100% capacity of raceway.
- .7 Provide split systems where existing cables are involved.
- .8 Provide Firestopping approval certificate. Submit a letter certifying that all work is complete and in accordance with this applicable building codes.

3.12 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.13 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.
- .5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.
- .6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.14 ACCESSIBILITY AND ACCESS PANELS

- .1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.
- .2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Departmental Representative.

- .3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.
- .4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Departmental Representative's approval.
- .5 Locate equipment and junction boxes in service areas wherever possible.

3.15 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.
- .2 CSA identification and equipment labels to be clearly visible after installation.

3.16 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.
- .3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.
- .4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Openings through structural members of the building shall not be made without the approval of the Structural Engineer.
- .6 Openings in Concrete:
 - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
 - .2 All openings shall be core drilled or diamond saw cut.
 - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .4 Refer to structural drawings for locations of steel reinforcing.
 - .5 Be responsible for repairing any damage to steel reinforcing.
- .7 Openings in building surfaces other than concrete:
 - .1 Lay out all openings required.

3.17 PAINTING

- .1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with section 00 01 50 General Instructions.
- .2 Do verification requirements in accordance with Division 01 Sustainable Requirements: Contractor's Verification.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 PCB (POLYCHLORINATED BIPHENYLS)

- .1 Carefully remove any electrical items containing PCB's (eg light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

1.5 SCOPE

- .1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.
- .2 The Electrical Division to also take note of the dust containment requirements as outlined in the architectural and front end specification.
- .3 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .4 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Departmental Representative who will provide instruction.
- .5 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

1.6 SCHEDULING

- .1 Refer to Division 01 and 02.

1.7 EXAMINATION

- .1 Refer to Division 01 and 02.

1.8 PHASING

- .1 Refer to Division 01 and 02.

1.9 PROTECTION

- .1 Refer to Division 01 and 02.

Part 2 Products

2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 EXECUTION

3.1 DEMOLITION

- .1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

- .1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

3.4 DISTRIBUTION OF CIRCUITS

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Departmental Representative. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Departmental Representative before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

- .1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.
- .2 Remove all accessible (eg. Surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

3.6 FIRE ALARM SYSTEM

- .1 Construction/demolition activities in existing building may require that certain fire alarm devices are protected from construction dust, damage etc. Coordinate with the Departmental Representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.
- .2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The “construction” detectors to be removed and discarded at the end of the project.
- .3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification to minimize false alarms and to ensure other occupants of the building are protected.
- .4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary fire alarm devices and audible signals to suit any temporary exiting provisions.

- .5 Contractor to check in with the Departmental Representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to construction dust to be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture to be replaced immediately.
- .6 The fire alarm system is to be fully functional in the area of construction when the contractor is neither on site nor after the contractors normal work hours. (ie overnight, holidays, weekends)

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated. Refer to “Site Services” Section for allowable site conduits as an alternative to steel.
- .2 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating. Tech cable may be used for exterior condensing unit feeders, cables to be routed using existing pathways where possible.
- .3 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .4 Refer to Mechanical Schedule(s) for detailed responsibilities.
- .5 Non-metallic sheathed wiring is not to be used on this project.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Division 01.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .3 Use RWU90XLPE for underground installations.

- .4 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 conduit fittings. Conductors not to be painted.

2.2 TECK 90 CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors: copper and sized as indicated.
- .3 Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90XLPE,600V
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat galvanized steel.
- .6 Overall covering: PVC jacket with FT-4 flame spread rating. PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .7 Fastenings:
 - .1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two (2) or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: Watertight approved for TECK cable

2.3 ARMoured CABLE (BX)

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 600 V rated.
- .3 Armour: interlocking type fabricated from galvanized steel.
- .4 Anti-short connectors.

2.4 ALUMINUM SHEATHED CABLE

- .1 Conductors: insulated copper, size as indicated.
- .2 Insulation: type RA90 rated 600 V.
- .3 Sheath: aluminum applied to form continuous smooth or corrugated seamless sheath.
- .4 Outer jacket of PVC applied over sheath for direct burial and wet locations.

- .5 Fastenings for aluminum sheathed cable:
 - .1 One hole aluminum straps to secure surface cables 25 mm and smaller. Two hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.

2.5 LOW VOLTAGE CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.
- .2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

2.6 WIRE & BOX CONNECTORS

- .1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.
- .2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.
- .3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors
- .4 Clamps or connectors for armoured cable, flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install all cables and wiring.
- .2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.
- .3 Group Teck, Armoured, MI & Sheathed cables on channels wherever possible.
- .4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.
- .5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.
- .6 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.
- .7 Colour coding to be strictly in accordance with Section 26 05 00.
- .8 Provide sleeves where cables enter or exit cast concrete or masonry.

- .9 Power wiring up to and including No.6 gauge shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.
- .10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.
- .11 All branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .12 Install all control cables in conduit.
- .13 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

- .1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.
- .2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2 All grounding conductors to be stranded soft annealed copper unless otherwise noted.
- .3 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 TESTING REQUIREMENTS

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

1.5 ADDITIONAL SCOPE

- .1 Refer to drawings for extent of grounding in addition to code requirements.

Part 2 Products

2.1 MATERIALS

- .1 Grounding equipment to: CSA C22.2 No.41.

2.2 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified or required to be green.

2.3 INSTALLATION GENERAL

- .1 Expand existing complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories to suit new equipment.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install 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.
- .7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .9 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .10 Provide a bonding conductor appropriately sized within each raceway routed within the building.
- .11 All bonding and grounding connections to be compression type unless noted otherwise.
- .12 Expand existing system as required to provide complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.
- .13 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.
- .14 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.
- .15 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.
- .16 Bond all low tension equipment with #6 AWG bonding conductor.
- .17 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

2.4 EQUIPMENT GROUNDING OR BONDING

- .1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, UPS, control panels, building steel work, generators, elevators, distribution panels and outdoor lighting.

2.5 MECHANICAL EQUIPMENT GROUNDING

- .1 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

2.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .3 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.
- .4 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCES

- .1 All conduits and accessories to be manufactured and certified by the related CSA standard.

1.4 SCOPE

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.
- .3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Departmental Representative where exposed wiremold may be substituted.
- .4 Note particular requirements for routing of conduits where detailed.
- .5 Provide polypropylene pull cord in all “empty” conduits.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 41mm [1.5”] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5”].
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 10mm [3/8”] threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90 degree bends are required for 27mm [1"] and larger conduits.
- .3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.
- .2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm [3/4"] deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" or equal.
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.
- .3 Solvent: as recommended by conduit manufacturer.

2.6 OUTLET AND CONDUIT BOXES IN GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm [4"] 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 [1.25"]. 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 [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4"x 2"] outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.
- .2 For larger boxes use GSB solid type as required.
- .3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers; or equivalent.
- .4 Lighting fixture outlets: 102 mm [4"] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 102 mm [4"] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

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. (BX cable has been allowed in corridor ceiling space due to congestion and limited space.)
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
- .3 Where practical conceal conduits.
- .4 Any conduit exposed in finished areas to be free of unnecessary labels and trademarks.
- .5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.
- .6 Ensure grounding continuity in all conduit systems.
- .7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.
- .8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5'] above the finished floor.
- .9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

- .10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
- .11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
- .12 All branch circuit conduit, home-runs and communication/data conduits to be minimum 21 mm [3/4"] diameter unless otherwise indicated.
- .13 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.
- .14 Locate conduits more than 75mm [3"] parallel to steam or hot water lines with a minimum of 25mm [1"] at crossovers.
- .15 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.
- .16 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .17 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.
- .18 Damaged conduits to be repaired or replaced.
- .19 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .20 Conduits shall not pass through structural members except as indicated.
- .21 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.
- .22 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.
- .23 Seal conduits with approved sealant where conduits are run between heated and unheated areas.
- .24 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.
- .25 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.
- .26 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels, or equivalent.
- .27 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.

- .28 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.
- .29 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5'] clearance.
- .3 Conduits to be run in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SURFACE RACEWAYS

- .1 Where practical provide regularly spaced device outlets and factory pre-cut raceway covers and cover plates. Field install outlets where factory installation is not possible due to delivery issues or irregularly spaced outlet requirement. In this event covers may be field cut with proprietary factory cover shear equipment with sharp blades.
- .2 Raceways shall be free of burrs inside and out.
- .3 Covers to be matching colour, smooth, free of burrs and parallel with no gaps.
- .4 Preserve and organize the space within the wireway to facilitate multiple wiring runs and future additions. In finished areas and where practical, conduit to feed the surface raceway from a box recessed behind and via grommetted openings to the back of the surface raceway. Maintain pullbox access as required by the Canadian Electrical Code.

3.4 BOXES INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm [0.25"] of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.

- .7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .8 No sectional or handy boxes to be installed.
- .9 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .10 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- .11 Outlets installed back to back in party stud walls to be off-set by one stud space.
- .12 Refer to wiring device and communication specification sections and to architectural layouts for mounting heights of outlet boxes.
- .13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.
- .14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.
- .15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Mechanical

1.2 REQUIREMENTS

.1 Provide a complete system of wiring to motors 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 all contracts related to this project. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other contracts.

.3 Unless specifically noted otherwise, supply all pushbuttons, 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.

.6 Assist in placing in operation all mechanical equipment having electrical connections.

.7 Provide all power wiring for all motors as indicated on the drawings.

.8 In general, wiring for freezestats, firestats, E.P. switches, P.E. switches, dampers, temperature controllers, flow switches, solenoid valves, etc., for heating ventilating and air conditioning equipment will be under a separate contract. Provide terminations in starters and MCC's 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.

.9 Refer to Mechanical Equipment Schedule.

.10 Some specific definitions of equipment wiring responsibilities are as follows:

.1 Fans

.1 Provide all 120V and 208V power wiring. Except where specifically noted otherwise, all control for fans is to be supplied, installed and wired from the starter control circuits to the equipment by mechanical contractor. Fire alarm and smoke detection systems shall be wired to shut down fans

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 EEMAC 4 enclosures outdoors and in damp and wet locations, and EEMAC 1 in indoor dry locations. Switches to be H.P. rated, Schneider Square D, or Eaton heavy duty type.

2.2 120 VOLT, 1 PHASE DISCONNECT SWITCHES

- .1 Manual starter without overload relay.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide disconnect switches adjacent to all motors.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 BREAKERS

- .1 All breakers to be bolt on type, moulded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208(240)V and with trip free position separate from "On" or "Off" positions.
- .2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:
 - .1 120/208V panelboards - 10,000 Amps at 250 volts.

2.2 PANELBOARD IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a “letter sized” paper copy of each directory in the project maintenance manual.
- .4 Provide a plasticized typewritten information card fixed to the back of each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a “letter sized” paper copy of each information card in the project maintenance manual.

Part 3 Execution

3.1 INSTALLATION

- .1 Connect loads to circuits as indicated.
- .2 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA C22.2 No.4, Enclosed Switches.
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 HEALTH AND SAFETY

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.5 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00 and 01 33 00 Submittal Procedures.

Part 2 Products

2.1 DISCONNECT EQUIPMENT

- .1 “Heavy Duty” class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA enclosure.
- .4 Provision for padlocking in off switch position.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 Weatherproof as required.

2.2 EQUIPMENT IDENTIFICATION

- .1 Indicate name of load controlled on size 4 name plate to Section 26 05 00.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide new weatherproof disconnect switches c/w circuit identification lamicaid for all new mechanical equipment located outdoors.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

- .1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Departmental Representative has given a special pre-approved circumstance.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REGULATORY REQUIREMENTS

- .1 The fire alarm system devices are to be installed in accordance the following standards:
 - .1 C.S.A. Standard C22.1, Canadian Electrical Code, Part 1 2009 and bulletins & amendments for British Columbia and as adopted by the City of Vancouver (where appropriate).
 - .2 The British Columbia Building Code 2006 edition and as adopted by the City of Vancouver (where appropriate).
 - .3 CAN/ULC S524-06: Standard for Installation of Fire Alarm System.
 - .4 CAN/ULC S537-04: Standard for Verification of Fire Alarm System.
- .2 Installation subject to approval of Departmental Representative and fire marshal for final acceptance.

1.4 SYSTEM

- .1 The existing fire alarm system will remain. The project scope is limited to removal of existing FA devices and installation of new FA devices that connect to the existing fire alarm system and graphics.
- .2 Equipment to be ULC approved.

1.5 WARRANTY/SERVICE

- .1 System installer to include with his base tender price a guarantee stating:
 - .1 Service to be provided on system within 24 hours of call origination during the warranty period.
 - .2 Full warranty on affected devices to be provided for a period of 12 months.

- .3 During warranty period the system installer at his expense shall repair and replace all such defective work and other work to the system damaged thereby which fails or becomes defective during the term of the warranty, provided that such failure is not caused by improper usage or physical damage.
- .4 Should the system installer fail to comply with Sub-item 1.1, work will be performed by others at the contractors expense.
- .5 Warranty date to commence from date of final acceptance of this work.

1.6 TESTS AND ADJUSTMENTS

- .1 Upon completion of system installation, tests to be conducted by the system installer to determine system conformity to requirements of the specification. Tests to be conducted in presence of the Departmental Representative who may suspend or discontinue tests at any time performance is considered unsatisfactory. Resumption of testing to cover the previously untested elements and any completed elements at the discretion of the Departmental Representative.
- .2 All equipment or wiring provided by system installer which tests prove to be defective or operating improperly to be corrected or replaced promptly at no additional cost to the Departmental Representative.

1.7 LABELLING – DEVICES AND PULLBOXES

- .1 Provide a ‘Brother’ style commercial quality label on each fire alarm device. Label to be clearly visible from the ground and contain the address information to correspond to the walk test voice or page.

Part 2 Products

2.1 GENERAL

- .1 All fire alarm devices are existing and are to be re-used.

Part 3 Execution

3.1 INSTALLATION

- .1 System installation shall conform to the latest CAN/ULC-S524 Standard for the Installation of Fire Alarm Systems.

3.2 AUTOMATIC DETECTORS

- .1 Locate automatic smoke and thermal detectors in locations as shown indicated.
- .2 Generally, locate ceiling mounted detectors centrally in rooms and corridors unless lights and/or mechanical devices interfere. Coordinate with other trades before proceeding.

- .3 Provide flush mounted devices in finished areas unless wiring is surface mounted in which case surface mounted devices shall be provided. Provide mounting base for surface mounted detectors
- .4 Maintain minimum 450mm [18"] clear to mechanical air diffusers and registers.
- .5 Typically maintain minimum 450mm [18"] clear in all directions around detectors.
- .6 Mount detectors out of line of direct heat and minimum 3m [10'-0"] from unit heaters.
- .7 Mount smoke detectors associated with smoke control doors, on the ceiling on either side of the doors; typically 1200mm [4'-0"] from door. Do not mount detectors closer than 900mm [3'-0"] or farther than 1500mm [5'-0"] from the doors.
- .8 Mount detectors shown in crawl spaces which have solid type joists or beams at the level of the underside of the joist or beam.
- .9 Install duct smoke detectors on the supply air side of fair handling units as indicated. Exact location of duct detectors to be coordinated with Division 23 and fire alarm system manufacturer.

3.3 WIRING

- .1 Make conductor terminations on fixed terminal strips with separate terminal for each conductor. No loose wiring connections allowed.
- .2 Fire alarm wiring splices to be minimal. Line splices are not acceptable.
- .3 Neatly install wiring clamped with nylon cable straps or laced with jute cord.
- .4 Number identify all wiring terminations and terminal strips as indicated on shop drawings.
- .5 Attach wiring diagram to inside of panel doors.
- .6 All cables crossing fire zones to be protected by 1-hour fire rating.
- .7 Provide separate fire alarm zone (and indicated at the graphic annunciators) for each duct mounted products-of-combustion detector for mechanical pressurization and recirculation units.
- .8 Coordinate duct detector location and accessibility. Provide remote LED's for locations not readily viewable by maintenance personnel.
- .9 Visual signal appliances to be wired independent from audible devices on the system.
- .10 All backboxes in exposed installations to be as provided by system manufacturer.

3.4 PROTECTION OF COMPLETED WORK

- .1 Protect equipment in areas of construction to prevent the entry of dust, paint and any other foreign matter into the devices or panels.

3.5 SYSTEM INSPECTION

- .1 Carry out a complete inspection and test of system on completion of the installation to ensure the following:
 - .1 System is complete and functional in accordance with the contract documents and regulatory requirements.
 - .2 System is installed in accordance with the manufacturer's recommendations.
 - .3 Fire suppression detection devices are connected into the system and are functioning.
 - .4 Smoke control equipment has been installed, connected and functioning.
 - .5 All auxiliary equipment has been connected and functioning.
 - .6 On completion of inspection deliver three (3) final sets of maintenance and operating instructions manuals to the Departmental Representative.

3.6 PERFORMANCE VERIFICATION

- .1 The Electrical Division Contractor shall be responsible for directing performance verification of the fire alarm system in accordance with the latest CAN-S537, Standard for Verification of Fire Alarm System Installations.
- .2 Provide interim partial verifications to suit the progress of the work and any staged occupancy. All work to be tested and verified directly following the installation.
- .3 Submit all verification reports to the Departmental Representative. Provide an unconditional Appendix C and written test reports from the equipment manufacturer showing that the system has been tested, verified and commissioned by him and that the Fire Alarm system complies with all points of the specifications. Include the verification worksheets identifying every device and its status (i.e. smoke detector - room xx, verified for operation and supervision).
- .4 The qualified Fire Alarm verification agency shall be independent of the installing company.
- .5 Prior to requesting the final performance verification ensure that fire alarm system is fully operable and that subsequent work to be performed on system will not invalidate examinations and tests performed during verification procedure.
- .6 Include all costs for fire alarm system verifications, including the Fire Alarm System Manufacturer's representative's costs. Take into account that the system may have to be commissioned and verified after normal working hours.
- .7 Provide a minimum of ten working days written notice ahead of the verification process to the Departmental Representative.

3.7 FIRE DEPARTMENT DEMONSTRATION

- .1 Arrange, attend and carry out a Fire Department demonstration of the completed system after the final unconditional verification.

- .2 Activate alarms and demonstrate all controls as requested.

END OF SECTION

Penticton Regional Airport
Penticton ATB Roofing & Building Envelope Project
Project: R.105676.001

APPENDIX A

Plan of Construction Operations

Part 1 General

1.1 BACKGROUND

- .1 Work under this Contract covers renovations and upgrades to Penticton Regional Airport Terminal Building at Penticton BC.
- .2 Work to be performed under this Contract includes, but is not limited to, the following items covered further in the Contract documents.
 - .1 Refer to 01 11 00 – Summary of Work.

1.2 COORDINATION OF WORK

- .1 The Contractor will liaise directly with the Penticton Airport Manager (APM) or delegate for coordination of access and activities in the Air Terminal Building and Restricted Areas.
- .2 The Contractor will liaise directly with the PWGSC Departmental Representative for all other matters.
- .3 Penticton Airport is a Transport Canada airport and requires specific procedures for communicating with airport users and tenants. The Penticton Airport Manager will liaise with airport users and tenants and with PWGSC Departmental Representative. Penticton Airport Manager is Kerri Haybittle-Raffel at 250-809-4596; also contact Lance Duncan at 250-460-2468.

1.3 THE AIRPORT ENVIRONMENT

- .1 The airport operational environment is dynamic and involves various stakeholders including Transport Canada, the users, airlines, Nav Canada, the operator (ie. Penticton Airport/Transport Canada), airport staff, security etc. In addition, the airport environment is highly regulated in the interest of public safety. As such, any deviations from standard operating procedures are carefully considered and subject to detailed review and input from the stakeholders and regulators.
- .2 This proposed construction project is considered very important to the Penticton Airport to ensure the continued viability of the safe operation of the facility. It is recognized that construction may temporarily impact the "normal" operation of the facility and may require special temporary operational changes. The cooperation of all parties including the constructor will be paramount in successfully carrying out this project.

1.4 THE PURPOSE OF THE PLAN OF CONSTRUCTION

- .1 The primary purpose of the Plan of Construction Operations (PCO) is to provide a notification of deviation from the certification standards and the Aerodrome Operations Manual (AOM) published for the Penticton Airport. The PCO is a statement of the approved operational procedures to be employed to maintain the certification criteria of the project planned for 2020.
- .2 The secondary purpose of the Plan of Construction Operations (PCO) is to formulate, in advance, the coordination required to implement this construction project with a minimum of interruptions and conflict with airport operations and ensure that airport security and flight safety are not compromised by the construction operations.
- .3 The third purpose of the PCO is to inform all airport users, tenants, Transport Canada, Nav Canada and air carriers of the project, so that they may appreciate and plan for the project's potential implications to their operations. Further, the PCO is important to summarize the information gathered through consultations with the stakeholders.

1.5 SECURITY AND ESCORTING REQUIREMENTS

- .1 All personnel and vehicle operators operating within airside facilities and outside of defined project areas will require an airside escort. All escorts must be approved by Airport Management. Contractor shall submit a written request minimum 48 hours in advance. Refer to 01 32 19 for escort requirements.

1.6 COMMUNICATION PROTOCOLS AND RESPONSIBILITIES

- .1 Communication Protocols and Responsibilities
 - .1 During construction, communication protocols and responsibilities must be clearly understood, practiced and enforced. Figure 1 shows the general communication flow during the project. The following provides additional details as to the responsibilities of the major project participants.
- .2 Airport Operator / Airport Manager
 - .1 Transport Canada operates the Penticton Airport and is the “Airport Operator”.
 - .2 Nav Canada provides all air navigation services in Canada.
 - .3 Airport Management will liaise with Nav Canada during construction.

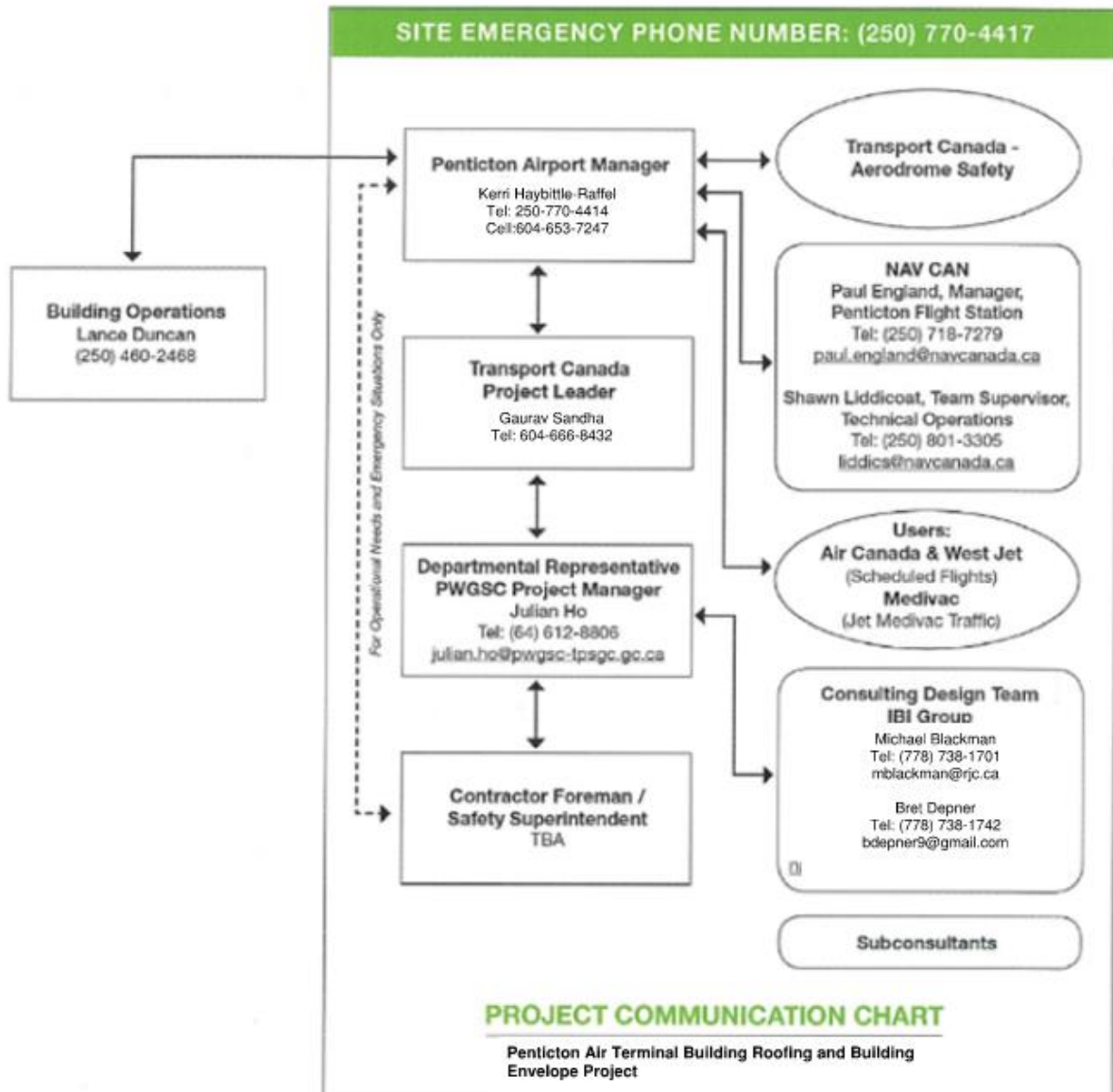
- .3 Departmental Representative
 - .1 PWGSC / Transport Canada has retained the services of a professional engineering firm specializing in Airport Engineering and construction. This firm is providing engineering , project management and site supervision services for the project.
 - .2 The Departmental Representative will monitor the progress of the Work. The Departmental Representative will communicate with the Contractor and/or their site personnel and provide updates/queries to the Airport Management.
 - .3 The Departmental Representative will also coordinate all technical issues during construction with the Airport Management and the Contractor.
- .4 Contractor:
 - .1 The Contractor will be responsible for the actual construction of the proposed Work. The Contractor will also designate a Representative who will be responsible for the overall coordination of their site activities and to act as a Safety Superintendent and Site Foreman during construction.
- .5 Transport Canada Aerodrome Safety:
 - .1 Transport Canada Aerodrome Safety is interested in ensuring the continued safe operation of the airport and that all applicable regulations, standards and recommended practices are complied with. Periodic inspections may be conducted during the construction period do ensure the intent of this Plan of Construction is followed.
 - .2 Only Airport Management shall communicate with Transport Canada Aerodrome Safety.
- .6 Nav Canada FSS:
 - .1 Nav Canada provides air traffic advisory services in Penticton from their FSS (Flight Service Station) which is located in the tower. Nav Canada personnel require clear understanding of the status of the project at all times.
 - .2 Only Airport Management shall communication with Nav Canada on matters related to this project.
 - 3 Notify Manager of the Flight Service Station and the Team Supervisor of Nav Canada Technical Operations minimum 2 weeks in advance of any work occurring in Equipment Room 136 or if there are any power outages/shutdowns during construction.

.1 Contacts as follows:

NAV CAN

Paul England Manager Penticton Flight Service Station
 (250) 718-7279
Paul.England@navcanada.ca

Shawn Liddicoat Team Supervisor, Technical Operations
 (250) 801-3305
LiddicS@navcanada.ca



1.7 AIRCRAFT OPERATIONS

- .1 The work is not anticipated to affect aircraft operations. Every effort by the Contractor is expected to ensure that aircraft operations are not affected by the work.
- .2 However, if any construction activities affects aircraft operations the runway or taxiway availability, the APM and PWGSC Departmental Representative are to be advised. The Penticton Airport Manager, will provide this information to the airline operators. Cooperation with airlines will be maintained to permit scheduled service to the maximum extent possible.
- .3 Under emergency situations, contractor will move all personnel and equipment to

pre-designated staging area. Major airlines operating scheduled flights have been briefed by Airport Manager and have agreed to construction schedule and staging.

1.8 AIRFIELD OPERATIONS

- .1 Staging areas outside of the designated work areas are not provided unless required. This is intended to minimize disruption of the airport operation. These routes may be updated, as required, in future meetings. Site operational requirements WILL take precedence.
- .2 Where existing access roads are to be used, the Contractor is required to maintain these roads in existing condition. Flag persons will be provided by the Contractor to control movements through any security gate which is left open for the convenience of the Contractor for hauling materials to and from the site. The Contractor will be responsible to lock these gates during non-working hours. At no time shall any gate with access to the airside be left unattended. The Penticton Airport Manager shall have discretion in this matter.

1.9 OPERATIONAL RESTRICTIONS

- .1 The Contractor's supply vehicles will not be permitted on airside service roads except as indicated on drawings. Refer to specification section 01 52 00 - Construction Facilities for Contractor employee parking.
- .2 Any impacts or restrictions on aircraft taxiing or parking operation will be kept to a minimum.

1.10 WORK RESTRICTIONS

- .1 Fire and Safety:
 - .1 Refer to specification Section 01 35 35 - Fire Safety Requirements.
 - .2 Refer to specification Section 01 35 33 - Health & Safety Requirements.
 - .3 The Penticton Airport Manager shall have the exclusive right to disallow any of the Contractor's personnel on to the construction site if it is found that any unsafe practices are observed and appropriate warnings and instructions are not followed.
 - .4 The Penticton Airport Manager is to be contacted immediately should there be any operational or environmental incidents or accidents.
- .2 Vehicle Operation:
 - .1 Access to unrestricted areas will be controlled by the APM or delegate and contractor. No access will be permitted to the airport's restricted aircraft operating areas when the airport is not closed during Work Hours for Construction. Any access, if required, beyond the established closure times will be requested by the Contractor. 48 hours advance notice is required for approval by the APM. All access of this nature will require an approved airport escort.
 - .2 All vehicles operating on airport property must do so in a safe fashion, in accordance with posted signs, traffic regulations and established airport operating procedure. Due consideration must be given to airport related vehicles, aircraft and pedestrian traffic.
 - .3 Advise Airport Manager (APM) of any equipment over 5 m in height. This will be permitted on site only during the night construction period.
 - .4 All vehicles to be operated on airport maneuvering areas must be equipped with a 360 degree rotating beacon, and valid Identification ID (e.g. driver's license) or accompanied by an escort vehicle with the required lighting.
 - .5 All persons entering airside will need a valid ID or security pass. Vehicles and personnel must be escorted by authorized vehicles and personnel.
 - .6 Submit a written request for access of vehicles on airside to Airport Manager (APM) 48 hours in advance.

- .3 Security:
 - .1 All airport security requirements will remain in effect throughout the construction project. All of the Contractor's staff will be required to adhere to security procedures as identified by the Penticton Airport Manager or delegate. The Penticton Airport Manager is to be supplied with a list of all the Contractor's personnel and vehicles to be working on airside.

- .4 Potential Foreign Object Damage (FOD):
 - .1 Penticton Airport will not tolerate Foreign Object Debris (F.O.D.). Under no circumstances will the Contractor be permitted to dispose of any F.O.D. while on site. F.O.D. will be monitored by Airport Management, and the Departmental Representative. Any F.O.D. observed must be removed immediately.
 - .2 It is operationally critical that all potential foreign object damage (FOD) be removed from active aircraft operational areas and safety areas. Materials and debris which can be tracked or blown on to the airfield areas can pose a risk to aircraft safety. Removal of potential FOD is a primary responsibility of the Contractor and will be closely monitored to ensure compliance. *Use power sweepers to clean and loose materials from the pavement surface. Appropriate waste containers must be supplied and used to contain the debris and emptied on a regular basis. All clean-up must be to the satisfaction of the Penticton Airport Manager. Failure of the Contractor to perform this requirement will result in the Penticton Airport Manager initiating the required clean-up and all costs incurred by the Penticton Airport Manager will be recovered from the Contractor.

- .5 Contractor Compounds:
 - .1 No equipment or material will be stored outside of the work area. All Contractor equipment is to be fully secured if stored within the compound site while not in use or after hours. All hazardous products must be stored according to applicable regulatory requirements.
 - .2 All contents of storage areas will be made known to the Penticton Airport Manager or designated representative to ensure precautions that may need to be taken are addressed.

- .6 The final decision concerning any storage area location lies with the Penticton Airport Manager.

1.11 MEDIA

- .1 Contractor to forward any media items/inquiries to the Departmental Representative. Do not provide any project information to the public or media.

1.12 INSPECTIONS

- .1 All formal construction inspections will be coordinated by the PWGSC Departmental Representative as noted in the specifications section 01 45 00 - Quality Control.
- .2 All projects being implemented on airport property are subject to inspection by the Penticton Airport Manager or designated representative at any time. Any resulting issues will be resolved by the Contractor immediately.

1.13 CONSTRUCTION MEETINGS

- .1 Refer to specification sections 01 10 01 - General Requirements for information on Construction Meetings.

1.14 REMOVAL AND SALVAGE OF MATERIAL

- .1 Refer to specification 01 74 19 – Waste Management and Disposal for additional requirements.

1.15 SITE CONDITIONS

Refer to specification 01 10 01 – General Requirements

1.16 VEHICLE SAFETY REQUIREMENTS

- .1 Vehicles and equipment operating on the airside at the airport will be working in area closed to aircraft traffic. No vehicle will be permitted to operate on an active aircraft maneuvering area unless the operator is under escort from a qualified Airport Escort having appropriate AVOP (Airside Vehicle Operators Permit) clearance and Restricted Radio License.
- .2 All vehicles that will be operated or driven on the aircraft maneuvering areas of the aerodrome (open or closed) will be equipped with a yellow warning beacon that will be turned on while the vehicle is on these areas. If equipped with headlights, these will also be turned on.

- .3 A yellow warning beacon will be mounted on each vehicle in a location this will permit the beam to be seen by aircraft or surface traffic from any position within a 360 degrees. If a rotating beacon is used, the light beam shall be set at an angle of 6 degrees above the horizontal and it shall rotate at a constant speed of 35 r.p.m. The enclosing globe of the warning light shall be a yellow or amber for all vehicles. The flash frequency for mobile object will be 60 to 90/min.

1.17 GENERAL SITE PROCEDURES

- .1 General
 - .1 The Contractor's Safety Superintendent/Construction Foreman shall be responsible for ensuring that all construction personnel at the aerodrome operate construction equipment and services vehicles in a safe manner in accordance with the procedure outline in this document and the Contract Plans and Specifications.
 - .2 Prior to the start of construction the Construction Foreman in conjunction with Airport Management, Airport Escort and the Departmental Representative shall brief all key project/construction personnel on:
 - .1 Site access.
 - .2 Construction limits,
 - .3 Security regulations, and
 - .4 Other applicable aerodrome directives.
 - .3 The Construction Foreman shall ensure that all new personnel to the project are briefed.
 - .4 When required, the Airport Manager shall advise Nav Canada flight Service Stations (FSS) of any deviations of construction activities at the airport relative to this approved Plan of Construction Operations. No deviations to the PCO are allowed unless approved by the Airport Manager.
 - .5 FSS is responsible for providing cautionary advisories to aircraft and the Airport Escort.
 - .6 A NOTAM will be issued for the duration of the construction project indicating construction activities and closures for all stages of the project. NOTAM coordination shall be the responsibility of the Airport Management.

- .7 Notwithstanding any of the above, all equipment shall depart all, or portions of, the constructing areas for operation reasons if requested to do so by the Airport Manager, the PWGSC Departmental Representative, or their designates. This requirement will normally only apply during inclement weather when limited visibility on the ground could create hazardous conditions for aircraft and construction equipment. During these situations the Contractor may be required to move equipment and personnel to a designated positions within 30 minutes notice.
- .8 Storage of equipment and materials shall only be in the designated as directed by airport staff.
- .2 Scheduled Flights:
 - .1 Scheduled air service to the Penticton Airport is presently provided by Air Canada and West Jet. Construction will not affect scheduled flights.
- .3 Unscheduled Flights:
 - .1 Construction will not affect unscheduled flights.
- .4 Weekly Construction Progress Meetings:
 - .1 Daily briefings are held throughout the construction period. The purpose of the meetings will be to review past and future progress and construction issues.
 - .2 Daily briefings are only with the on-site Airport Manager and formal progress meeting are bi-weekly per 01 10 01 – General Requirements.

1.18 NOTAMS AND RESPONSIBILITIES

- .1 Airport Management will be responsible for the origination, revision and cancellation of NOTAMs. The NOTAM will advise the aviation community of the establishment, condition or change in any aeronautical facility, service, procedure of hazard as well as the approximate time period involved.
- .2 Incident Reporting Procedures
 - .1 If an ‘Aviation Occurrence’ accident or incident occurs onsite during the construction project, the incident will be reported as per onsite procedures, as outline in the Airport Operations Manual (AOM). Airport Management will be responsible for initiating and carrying out this work.

1.19 STAKEHOLDER CONSULTATION

- .1 The Departmental Representative will send a copy of the Plan of Construction Operations (PCO) to Airport Management.
- .2 During the construction period, communications with the airlines and tenants will be the responsibility of the Airport Management. The Departmental Representative will be responsible for the coordination of information between Airport Management and the Contractor. Any changes to the plan as outline within this document will be communicated as required by Airport Management.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Penticton Regional Airport
Penticton ATB Roofing & Building Envelope Project
Project: R.105676.001

APPENDIX B1

Pre-construction Hazardous Building Materials Assessment



**Pre-construction Hazardous
Building Materials Assessment**

Roof and Building Envelope Renovation
—Air Terminal Building at the Penticton
Regional Airport, 3000 Airport Road,
Penticton, BC

June 15, 2021

Prepared for:

Public Services and Procurement
Canada, Pacific Region
401-1230 Government Street,
Victoria, BC V8W 3X4 on Behalf of
Transport Canada

Prepared by:

Stantec Consulting Ltd.
500-4730 Kingsway
Burnaby, BC V5H 0C6

Project Number: 123221854

Executive Summary

Stantec Consulting Ltd. (Stantec) was commissioned by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) to conduct a pre-construction hazardous building materials assessment of the Air Terminal Building at the Penticton Regional Airport located at 3000 Airport Road, Penticton, British Columbia (subject building), which was reportedly constructed in 1963.

The purpose of the assessment was to check for potential hazardous building materials that may require special attention in accordance with applicable federal and provincial regulations, prior to planned roof and building envelope renovation activities (the Project) which are to include the following:

- replace portion of the ATB's existing roofing and building envelope
- removal of the existing roofing, building siding, windows, skylights and doors

The work was carried out in accordance with the requirements of the following:

- Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR)
- British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97)
- WorkSafeBC 2017 publication "Safe Work Practices for Handling Asbestos" (BC Asbestos Guide)
- WorkSafeBC 2017 publication "Safe Work Practices for Handling Lead" (BC Lead Guide)
- PSPC June 5, 2017 "Asbestos Management Standard" (AMS) and "Asbestos Management Directive" (AMD)

The hazardous building materials considered during this assessment included the following:

- asbestos-containing materials (ACMs)
- lead including lead-containing paints (LCPs)
- polychlorinated biphenyls (PCBs)
- mould-impacted materials
- equipment with elemental mercury
- equipment with ozone-depleting substances (ODSs)
- building materials that may contain silica.

Based on Stantec's visual assessment and the laboratory analyses performed on the samples collected, as well as a review of a previous report regarding hazardous building materials, hazardous building materials were identified to be present in relation to materials or areas anticipated to be impacted by the Project.



PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

A summary of our findings is presented in Table ES.1, below. Recommendations pertaining to the handling, removal, transportation and disposal of identified hazardous building materials are provided in the body of this report.

Table ES.1 Summary of Findings

Hazardous Building Material	Summary of Findings in Relation to Building Materials
Asbestos	<p>The following ACMs have been identified and are anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Texture coat/stucco applied to exterior walls and soffit (previously identified) • Grey window putty applied between pane and frame on interior (previously identified) • Grey window frame caulking applied between frame and wall on exterior (identified through current assessment) <p>These materials were observed to be in good condition.</p> <p>The following ACMs have been identified and are unlikely to require alteration or impacts during the Project:</p> <ul style="list-style-type: none"> • Drywall joint compound applied to walls and ceilings throughout (previously identified) • Grey capped concrete pipe protruding out of ground exterior to the NAVCAN Telecom (136) (previously identified) <ul style="list-style-type: none"> – Similar piping may be present in other areas or below ground. <p>These materials were also observed to be in good condition. These materials may require consideration if project requirements change.</p>
Lead	<p>The following LCPs have been identified and are anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Brown (blue under) paint on metal doors and window frames (previously identified) • Grey paint on exterior texture coat/stucco wall patch of the raised portion of the roof (previously identified) • White paint on exterior wood soffit of the raised portion of the roof (previously identified) • Dark brown paint on exterior wood trim (previously identified) • Light brown (blue under) paint on metal doors (previously identified) <ul style="list-style-type: none"> – Painted dark brown on exterior of doors • Grey paint on exterior wood lower walls and trims of Customs Office (117), Airport ECCC (118), Airport Conference Room (120) and NAVCAN Office (123) on airside of the building (identified through current assessment) <p>These materials were observed to be in good condition.</p> <p>The following LCPs have been identified and are unlikely to require alterations or impacts during the Project:</p> <ul style="list-style-type: none"> • Yellow paint on steel pipes on roof (previously identified) • White, tan and light grey paint on exterior concrete foundation (previously identified) • White paint on exterior tar/concrete foundation (previously identified) • Beige paint on metal Lennox air handling units on roof (identified through current assessment) • Green paint on metal vent casings on roof (identified through current assessment)



PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Table ES.1 Summary of Findings

Hazardous Building Material	Summary of Findings in Relation to Building Materials
Lead (cont'd)	<p>These materials were also observed to be in good condition. These materials may require consideration if project requirements change.</p> <p>Analysis of bulk samples that were collected in a form presumed to be representative of waste generated during the Project indicated that the following materials contain lead in a dispersible form such that their leachates contain greater than 5.0 milligrams per litre (mg/L) lead, and will require special disposal:</p> <ul style="list-style-type: none"> • Exterior white painted wood soffit materials on the raised portion of the roof <p>Lead may also be present in the following materials, which are anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Older electrical wiring materials and sheathing • Vent and pipe flashings
Polychlorinated biphenyls (PCBs)	No suspected PCB-containing equipment was observed that are anticipated to be impacted by the Project.
Mould	Suspect mould or moisture-impacted building materials that are anticipated to be impacted by the Project were not observed at the time of the assessment.
Mercury	Items suspected to contain liquid mercury or mercury vapour that are anticipated to be impacted by the Project were not observed at the time of the assessment.
Ozone-depleting substance (ODS)	<p>The following equipment was identified by labels to be ODS-containing:</p> <ul style="list-style-type: none"> • One rooftop Lennox HVAC unit labelled "ACU-2" (R-22, 4 lbs., 12 oz.) • One rooftop Lennox HVAC unit labelled "ACU-4" (R-22, 4 lbs., 12 oz.) • One rooftop Lennox HVAC unit labelled "ACU-5" (R-22, 7 lbs.) <p>The following equipment is suspected to be ODS-containing (labels were not accessible):</p> <ul style="list-style-type: none"> • One wall-mounted Friedrich A/C on exterior of the Data/LAN room (127) <p>Although the above-noted equipment may not necessarily be replaced during the Project, it will likely require alteration or relocation.</p>
Silica	<p>Silica is expected to be present in the following, which were observed in various locations throughout, and are anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Stucco • Asphalt and asphalt products containing rock or stone (e.g., roof membrane)

The statements made in this Executive Summary text are subject to the same limitations included in this report and are to be read in conjunction with the remainder of this report.



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PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

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Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-containing material
AIHA	American Industrial Hygiene Association
AMD	Asbestos Management Directive
AMP	Asbestos Management Plan
AMS	Asbestos Management Standard
BC	British Columbia
BC Asbestos Guide	WorkSafeBC 2017 publication <i>Safe Work Practices for Handling Asbestos</i>
BC Lead Guide	WorkSafeBC 2017 publication <i>Safe Work Practices for Handling Lead</i>
BC Reg. 296/97	British Columbia's Occupational Health and Safety Regulation
CCA	Canadian Construction Association
COHSR	Canada Occupational Health and Safety Regulations
ELLAP	Environmental Lead Laboratory Approval Program
EMSL	EMSL Canada Inc.
EPA	Environmental Protection Agency
HUD	Housing and Urban Development



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HVAC	heating, ventilation and air conditioning
IAQ	Indoor Air Quality
LCP	lead-containing paint
NVLAP	National Voluntary Laboratory Accreditation Program
NYC	New York City
ODS	ozone-depleting substance
OEL	occupational exposure limit
PCB	polychlorinated biphenyl
PLM	polarized light microscopy
PSPC	Public Services and Procurement Canada
TC	Transport Canada
USEPA	United States Environmental Protection Agency



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Introduction
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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was commissioned by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) to conduct a pre-construction hazardous building materials assessment of the Air Terminal Building at the Penticton Regional Airport located at 3000 Airport Road, Penticton, British Columbia (subject building), which was reportedly constructed in 1963.

The purpose of the assessment was to check for potential hazardous building materials that may require special attention in accordance with applicable federal and provincial regulations, prior to planned roof and building envelope renovation activities (the Project) which are to include the following:

- replace portion of the ATB's existing roofing and building envelope
- removal of the existing roofing, building siding, windows, skylights and doors

The work was carried out in accordance with the requirements of the following:

- Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR)
- British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97)
- WorkSafeBC 2017 publication "Safe Work Practices for Handling Asbestos" (BC Asbestos Guide)
- WorkSafeBC 2017 publication "Safe Work Practices for Handling Lead" (BC Lead Guide)
- PSPC June 5, 2017 "Asbestos Management Standard" (AMS) and "Asbestos Management Directive" (AMD)

The hazardous building materials considered during this assessment included the following:

- asbestos-containing materials (ACMs)
- lead including lead-containing paints (LCPs)
- polychlorinated biphenyls (PCBs)
- mould-impacted materials
- equipment with elemental mercury
- equipment with ozone-depleting substances (ODSs)
- building materials that may contain silica.

The site work was conducted by Mr. Steve Chou on May 17, 2021.



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1.1 UNDERSTANDING OF THE PROJECT

The following documentation related to hazardous building materials was reviewed prior to undertaking the assessment:

- SNC Lavalin Inc. Report No. 636476 entitled *Hazardous Building Materials Assessment; Penticton Airport Terminal Building, 3000 Airport Road, Penticton, BC*, dated March 31, 2016, prepared for Public Works and Government Services Canada (2016 SNC Report)

This documentation provided Stantec with an understanding of hazardous building materials that are anticipated to be present at the subject building. According to the above-noted document, the following hazardous building materials were previously identified:

- various ACMs, LCPs, ODSs, potential PCB-containing light ballasts, mercury-containing thermostats and silica containing building materials

Based on the limitations of the 2016 SNC Report, PSPC commissioned this assessment as a measure of diligence in maintaining compliance with the COHSR and BC Reg. 296/97 pertaining to the identification of hazardous materials prior to planned renovations.

2.0 SCOPE

The planned scope of work for this assessment involved the following:

- review of existing information, including site drawings, previous assessment documentation and discussions with site personnel
- visual assessment of readily accessible areas for the presence of suspected hazardous building materials anticipated to be impacted by the Project
- collection of representative bulk samples from building materials suspected to contain asbestos fibres that are anticipated to be impacted by the Project
- collection of paint chip samples for the determination of the lead content in paint finishes that are anticipated to be impacted by the Project
- collection of bulk samples of painted building materials forms presumed to be representative of waste generated during renovation for the determination of whether waste may be considered a toxic leachate (and require special disposal)
- submission of samples collected for laboratory analysis
- evaluation and interpretation of field findings along with current and previous sample analytical results to develop conclusions and recommendations pertaining to hazardous building materials identified that are anticipated to be impacted by the Project



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2.1 LIMITATIONS

This report has been prepared for general information purposes to support the Project. This report does not necessarily constitute an assessment that would be sufficient to support other renovation projects or building demolition, which would typically require destructive removal of building finishes to observed concealed conditions. Prior to any other renovation or demolition work within the subject building, this report must be reviewed by an appropriately qualified professional (with education and experience associated with the management of hazardous building materials) to determine what, if any, additional assessment is necessary.

In preparation of this report, Stantec used professional judgment based on experience. The work was conducted in accordance with generally accepted professional standards. Stantec relied on information gathered during the site investigation and laboratory analytical reports.

This report reflects the observations made within accessible and accessed areas of the subject building in relation to those materials and areas anticipated to be impacted by the Project, and the results of analyses performed on the specific material sampled during the assessment by Stantec. Analytical results reflect the sampled materials at the specific sample locations.

This report has been prepared for the exclusive use of the Client for the purpose of assessing general conditions of materials and areas anticipated to be impacted by the Project. Any use that a third party makes of this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

2.1.1 Physical and Sampling Limitations

Assessment was limited to materials and areas anticipated to be impacted by the Project. Sampling was conducted pertaining to suspected ACMs, suspected LCPs and bulk building materials coated with paint presumed to be destined for landfill disposal. The assessment for the presence of other hazardous building materials was visual in nature and was conducted pertaining to readily visible surfaces within accessible spaces only. Concealed spaces were inspected via existing access panels, where present. Exterior finishes, solid ceilings, walls, flooring and structural elements were not removed to access concealed areas.



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Due to limitations on the agreed to scope of work for this project, there are specific limitations to the information that can be provided to each hazardous building material considered in this assessment, as outlined below.

- Building materials that may be present and that may contain asbestos but were not accessible for sampling include, but are not limited to the following:
 - insulation or other materials inside wall or ceiling cavities
- Samples of paint applications suspected to contain lead were collected from surfaces of major paint applications where visually different paint colours and/or types were identified. Although the surfaces where samples were collected may be covered with more than one coat of paint, the paint samples are described by the surface (visible) colour only. Attempts were made to represent all layers of paint in the samples collected. As analytical results are referenced to the surface paint colour only, the lead content of all painted surfaces similar to that represented by the surface paint colour were presumed to be the same, regardless of differing sub surface paints, if any.
- Sampling for analysis of lead leachate was conducted such that building material samples were collected in a form presumed to be representative of waste generated during the Project. The lead leachate samples are meant to represent the general waste that would be created when painted surfaces are demolished, without having paint removed.
 - Materials such as metal and concrete that are coated with LCPs are typically not tested for leachable lead content for the following reasons:
 - o If removed with paint in-tact, these materials are expected to be recycled, not disposed of via landfill. As such, the leachable lead content will not impact the “disposal” option, as recycling facilities will typically accept metal or concrete with lead-containing paint.
 - o If removal of the paint from the substrate is considered, the waste associated with that process (paint chips and removal substrate—sand, beads, etc.) is typically presumed to be hazardous waste (leachable for lead in excess of 5.0 mg/L) or must be tested in its actual form (once removed, with the removal substrate) to confirm.
 - o In most cases, during an initial assessment, it is not practical to try to remove sufficient paint from the substrate in order to appropriately analyze for lead leachate, as a significant area would have to be “scraped” (50–100 g of sample is required).



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- Due to height restrictions and the risk of electrical shock in handling operational light fixtures. Conclusions and recommendations regarding the presence of PCBs are based on limited observations and is presented to provide guidance regarding the likelihood that PCB-containing equipment is or is not present. The exact extent and/or number of fluorescent lamp ballasts containing PCBs, if any, will not be commented on.
 - Although they may also be present in other items in limited amounts (e.g., plastics, molded rubber parts, applied dried paints, coatings or sealants, caulking, adhesives, paper, sound-deadening materials, insulation, or felt and fabric products such as gaskets), PCBs are not expected to be present in those materials in concentrations that would necessitate the requirement for PCB-specific handling procedures, separate removal and/or disposal considerations for renovation or demolition. As such, these items were not considered in our assessment.
- Visual assessment for the presence of suspected visible mould and/or suitable conditions for mould growth (e.g., moist and/or water-stained building materials) was conducted. The conclusions made in this report provide description(s) of the potential source(s) of moisture that may have led to suitable conditions for mould growth, only in those cases where potential source(s) of moisture were identified. The visual assessment did not include an intrusive assessment. The conclusions provided herein will not necessarily identify all sources of moisture leading to suitable conditions for mould growth within the impacted area(s).
 - This assessment does not constitute a building envelope/building systems assessment, which would include an intrusive investigation to assess the internal condition, potential moisture sources, and expected remaining service life of the various components and systems comprising the envelope of a building.
- Potential presence of mercury or mercury-containing equipment in inaccessible areas or as internal parts of heating, ventilation and air conditioning (HVAC) mechanisms or other equipment was not assessed.
 - Although limited amounts of mercury may be present in paints and adhesives, mercury is not expected to be present in those materials in concentrations that would necessitate the requirement for mercury-specific handling procedures, separate removal and/or disposal considerations for renovation or demolition. As such, these items were not considered in our assessment.
- Investigation was limited to a visual review in accessed areas of readily accessible building-related cooling and refrigeration equipment which could contain ODSs. Testing was not conducted.
- In general, the assessment for the presence of hazardous building materials was visual in nature and was conducted pertaining to readily visible surfaces within accessible accessed spaces only, and only in relation to those materials and areas anticipated to be impacted by the Project. Additional hazardous building materials are potentially present in inaccessible areas not assessed including, but not limited to: ceiling spaces, wall cavities, crawlspaces, and buried materials.



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2.1.2 Project-Specific Limitations

The areas included in this assessment were limited to the following:

- Areas identified by PSPC that are expected to be impacted by the Project as indicated in the floor plan drawings provided in Appendix B.

The assessment completed was specific to the above noted area(s), and only considered those building materials that were anticipated to be impacted during upcoming planned renovation work.

This assessment does not comprise a comprehensive hazardous building materials assessment of the subject building.

2.1.3 Information from Previous Reports

Stantec reviewed the previous report outlined herein for information purposes only. Although the information provided in the documentation outlined in Section 1.1 was reviewed and considered in developing our sampling plan, Stantec did not rely entirely on the documentation or all of the sample analytical results within. However, for the purposes of this report and in accordance with the Client's direction, where previous sampling and analytical data indicated the presence of a hazardous building material (e.g., asbestos, lead), additional sampling was not conducted, and the material was considered to be hazardous.

Supplemental sampling of previously sampled materials was conducted in those instances where such sampling was required to bring the information into compliance with current regulations as they pertain to minimum sample numbers to appropriately characterize the sampled building material(s).

3.0 FACILITY DESCRIPTION

The subject building is located at 3000 Airport Road, Penticton, British Columbia and consists of a main level attached to an airport control tower. The reported construction date of the building was 1963. Several additions and renovations were reported to have been completed over the years. The original construction and many renovation time periods are consistent with those dates when hazardous building materials were commonly used.

The typical structural components, mechanical components and building finishes associated with this building consist of the following:

- foundation—concrete slab on grade
- exterior siding—combination of metal, wood and stucco
- structural—wood/steel framing
- mechanical—rooftop HVAC units with metal ducted supply
- roofing—combination of asphalt and metal cladding



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4.0 HAZARDOUS BUILDING MATERIALS ASSESSMENT

Methodology, findings and recommendations are provided on a material-by-material basis in the following sub-sections, for each of the hazardous building materials considered in this assessment.

Background information and health effects information, as well as information regarding regulatory framework and relevant legislation with respect to hazardous building materials are provided in Appendix A.

Floor plans showing the locations of samples collected during this assessment as well as identified hazardous building materials (where practical) are provided in Appendix B.

4.1 ASBESTOS

4.1.1 Methodology

The presence of asbestos in federal workplaces and pertaining to federally regulated workers is governed by the COHSR. According to the COHSR, ACM means:

- Any article that is manufactured and contains 1% or more asbestos (by weight) at the time of manufacture, or any material that contains 1% or more asbestos when tested in accordance with accepted methods.

The presence of asbestos in the workplace in British Columbia pertaining to provincially regulated workers is governed by BC Reg. 296/97. According to the current version of BC Reg. 296/97, ACM means any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos.

As both federally regulated workers and provincially regulated workers (e.g., contractors) are expected to carry out work activities within the subject building, and as the provincial regulations have a more stringent definition of ACM, and generally include the requirements noted in the COHSR, this assessment was conducted to meet the requirements of BC Reg. 296/97.

Based on these criteria, a visual assessment of accessible areas was undertaken to check for the presence of suspected ACMs. Locations to collect discrete bulk samples of suspected ACMs were identified and samples of representative materials were then collected at these locations.

Multiple samples were collected from each “homogenous application” of observed suspected ACMs (materials suspected to contain asbestos that are uniform in material type, colour, texture application and estimated installation date) and submitted to EMSL Canada Inc. (EMSL) in Burnaby, BC for analysis of asbestos content using polarized light microscopy (PLM) with dispersion staining, in accordance with the United States Environmental Protection Agency (USEPA) 600/R-93/116 method. EMSL’s analytical laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).



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The number of samples to be collected for each homogenous application of a suspected ACM was based on accepted occupational hygiene standards and protocols, on the recommendations provided in the Asbestos Guide, and on the assessor's experience and understanding of the consistency of that building material's application.

4.1.1.1 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 and require impacts as part of the Project. This included making note of and assessing attic spaces, floor cavities and masonry block or brick walls, which are typical areas where vermiculite is found.

4.1.1.2 Asbestos Sampling of Roofing Materials

Sampling activities pertaining to the roof were conducted with the assistance of Flynn Canada Ltd., as retained by Stantec. Flynn Canada Ltd. was responsible for both creating and repairing openings to allow for full-thickness sampling of available roofing layers by Stantec.

4.1.1.3 Sample Results Interpretation

When asbestos is detected in concentrations greater than 0.5% percent in one of the samples within a set that was collected to represent a "homogenous application" of a particular material (or detected in any concentration, in a set of samples collected for applications of vermiculite), the entire sample set, and the entire application of that material is then considered to be an ACM.

4.1.1.4 Asbestos Sampling Quality Assurance/Quality Control

Sampling activities pertaining to asbestos were conducted in accordance with Stantec's safe work practices, which take into account current provincial and/or territorial regulations pertaining to such work (i.e., sampling procedures, required number of samples and laboratory analytical procedures).

Representative bulk samples were collected of accessible suspect ACMs in sufficient quantities for laboratory analysis. Suspect ACM samples were sealed in polyethylene zip-lock bags labeled with the sample number, suspect material description, and sample location. As part of sampling procedures, sampling tools were cleaned between sample collection events to avoid the potential for cross-contamination of samples.

All sample bags were compiled in order and placed into a single container accompanied with a chain of custody form outlining the project information, date, building location, number of samples, and sample description. Samples were submitted to the analytical laboratory in a sealed container via courier.



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4.1.1.5 Assessment of Material Condition

A visual assessment of the condition and accessibility was also completed for each occurrence of suspect ACM. Criteria were generally based on the PSPC AMS, the provisions of the template RCMP Asbestos Management Plan (AMP) as communicated to Stantec, as well as industry standards of practice. Details on the criteria utilized are included in Appendix A.

4.1.2 Findings

A summary list of the bulk samples collected by Stantec, including a description of the material, sampling location and laboratory test results is provided in Appendix C. Copies of the Laboratory Certificates of Analysis for bulk samples analyzed are provided in Appendix D.

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of the analytical results of suspected ACMs collected through this assessment as well as the previous documentation reviewed as outlined herein, the materials presented in the table in Appendix E were identified as ACMs that may be impacted by the Project. The following information is included for each identified ACM:

- type of material that contains asbestos
- location/approximate extent of the ACM within the building
- asbestos type and percentage identified
- friability
- condition
- representative photographs, where available

In addition to those ACMs that will be impacted by the Project as indicated above, the following ACMs have been identified but are unlikely to require alteration or impacts during the Project:

- Drywall joint compound applied to walls and ceilings throughout (previously identified)
- Grey capped concrete pipe protruding out of ground exterior to the NAVCAN Telecom (136) (previously identified)
 - Similar piping may be present in other areas or below ground.

4.1.2.1 Non-Asbestos-Containing Materials

The bulk samples collected during this assessment for which no asbestos was detected through laboratory analysis can be seen in the table in Appendix C. Refer to the documentation in Section 1.1 for materials that have been previously sampled and identified as non-asbestos-containing through sampling and laboratory analysis.



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Materials Not Suspected to Contain Asbestos

Various materials within the subject building were observed and/or presumed to be present, which are not suspected to contain asbestos. Typical materials of this nature that were observed and are not considered suspected ACMs, include but are not limited to the following:

- Materials comprised of glass, such as:
 - window panes
 - lights and lighting components
- Materials comprised of metal, such as:
 - wall framing
 - flashings on siding or roofs
 - electrical wiring and conduit
 - components of doors, windows and associated trim
 - structural components
 - handrails
 - siding
 - roofing
- Materials comprised of wood, such as:
 - wall framing
 - components of windows and associated trim
 - structural components
 - siding
- Other materials generally not suspected to contain asbestos:
 - poured concrete items such as foundations and floors
 - silicone-based clear caulking or sealants

4.1.2.2 Potential for Vermiculite Insulation

No locations or materials that are anticipated to be impacted by the Project and that may potentially contain vermiculite (that could not otherwise be assessed) were observed. Masonry block wall construction that would require alteration, penetration or demolition as part of the Project was not observed.



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4.1.3 Recommendations

Stantec recommends the following with regards to meeting the requirements of the COHSR and BC Reg. 296/97 as they pertain to the managing asbestos during renovation projects:

- ACMs that may be impacted during the renovation activities should be removed by appropriately trained personnel (e.g., asbestos abatement contractor personnel), in accordance with the requirements of the COHSR, BC Reg. 296/97 and the Asbestos Guide, and prior to the initiation of project work that will disturb them.
- Should a material suspected to contain asbestos fibres become uncovered during renovation activities, 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 asbestos fibres are present. Confirmed ACMs should be handled in accordance with applicable guidelines and regulations.
- Suspected ACMs deemed visually similar to the ACMs identified in this report should be considered asbestos-containing and handled as such, unless proven otherwise, through analytical testing.
- Asbestos-containing cement pipe may be present below ground—caution should be used at any time when excavation is required.
- Ensure asbestos containing waste is handled, stored, transported and disposed of in accordance with the requirements of the Federal Transportation of Dangerous Goods Regulation and the British Columbia Hazardous Waste Regulation (BC Reg. 63/88).
- Due to the confirmed presence of asbestos within the subject building, and in accordance with the requirements of the COHSR, BC Reg. 296/97 and the Asbestos Guide, an asbestos exposure control plan (also known as an Asbestos Management Plan [AMP] or Asbestos Operations and Management Plan) must be developed and implemented for the subject building.
- Identified ACMs that are not being impacted by the Project and that are in good condition can be managed in place, upon development and implementation of an AMP.

4.2 LEAD

4.2.1 Methodology

A visual assessment of accessible areas was undertaken in order to check for the presence of materials that may be impacted by the Project and that contain lead. These materials included paint applications, wiring and plumbing, batteries, etc.



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4.2.1.1 Lead in Paint

With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, the 2011 WorkSafeBC manual titled *Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry*, indicates the following:

- Improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the exposure limit
 - The exposure limit indicated in both the COHSR and BC Reg. 296/97 is 0.05 mg/m³.
 - The potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan.
- Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children
 - Any risk assessment should include for the presence of high risk individuals within the workplace.

In addition to the above, the 2017 WorkSafeBC publication *Safe Work Practices for Handling Lead* (Lead Guideline) indicates the following:

Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.

When reviewing the above, “high risk” individuals are not expected to be present in the workplace associated with this building during operations and maintenance or building material alteration activities (i.e., renovation) that would create significant disturbance to paint with such individuals present. As such, Stantec will reference a value of >600 ppm in defining paints as “lead-containing” for the purpose of this report, such that appropriate risk assessments can be completed for ongoing operations and maintenance or renovation or demolition planning. However, information regarding the lead content of all paints tested is provided herein, for reference and risk assessment should the consideration of high risk individuals be necessary, based on the requirements of a particular situation.

Based on the above, samples of potential LCPs were collected from major paint applications, in sufficient quantity to conduct analysis for total lead content. The sampling of paint applications involved the collection of paint chip samples of paint layers to the substrate, where possible. A minimum volume of 5 cc or a half teaspoon of paint chips was typically collected. Wherever necessary and possible, paint was separated from any backing material such as paper, concrete or wood and placed in a sealed, clearly labelled plastic bag.

Samples collected were submitted to EMSL in Calgary, Alberta for analysis of total lead content using Environmental Protection Agency (EPA) Method SW 846 3050B*/7000B. EMSL’s analytical laboratory is also accredited by the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Approval Program (ELLAP).



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Welding, Burning or Torch Cutting

Although a concentration of 600 ppm lead has been used to define paint coatings as LCPs, it should be noted that this is related to painted surfaces and the determination of appropriate provisions to protect occupants and employees from exposure to elevated concentrations of lead during typical operations and maintenance or simple renovation. This does not include painted metal surfaces that are to be welded, burned or torch-cut.

Using an arc welder or oxyacetylene torch on steel that is coated with lead-containing paint can create hazardous lead fumes and is prohibited by section 12.115 of BC Reg. 296/97.

Regulatory excerpt: **12.115 Coatings on metals**

A coating on metal which could emit harmful contaminants (such as lead, chromium, organic materials, or toxic combustion products) must be removed from the base metal, whenever practicable, before welding or cutting begins.

In addition, the following information is provided in the Lead Guideline:

- Welding or torch cutting of paints or coatings on metal can create very high concentrations of airborne lead fumes. Torch cutting structural steel, coated with paint containing as little as 130 mg/kg (equivalent to ppm) lead, can release airborne levels of lead as high as 0.8 mg/m³ (16 times the exposure limit).

Given this information and that the analytical detection limit for lead paint analysis is approximately 80–90 ppm (not significantly different than 130 ppm, which, per above, may release airborne lead levels 16 times the exposure limit), any paint coating on a metal surface to be welded, burned or torch-cut must represent a potential lead exposure hazard.

4.2.1.2 Building Materials—Leachable Lead Content

According to BC Reg. 63/88, lead waste may be considered a toxic leachate (and require special disposal) if lead is in a dispersible form and its leachate contains greater than 5.0 mg/L lead.

Based on the above, bulk samples of painted building materials that would be expected to be disposed-of via landfill were collected in a form presumed to be representative of waste generated during the Project, each sample containing over 50 g in weight. The samples were submitted to EMSL in Calgary, Alberta.

Upon receipt and review of paint chip sample analytical results for total lead content, leachate analysis of building materials coated with identified LCPs was requested. Leachate analysis was conducted by EMSL through toxicity characteristic leaching procedure, using US EPA Method SW846, 1311/7420.



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4.2.1.3 Assessment of Paint Condition

The criteria for condition evaluation pertaining to LCPs described herein are generally based on the United States Housing and Urban Development (HUD) 2012 *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*, as summarized in Appendix A.

4.2.2 Findings

Lead is expected to be present in the following that are anticipated to be impacted by the Project:

- older electrical wiring materials and sheathing
- vent and pipe flashings

4.2.2.1 Lead in Paint

A summary list of the samples collected including a description of the samples, sampling locations and laboratory analytical results is provided in Appendix F. Copies of the Laboratory Certificates of Analysis for paint chip samples analyzed are included in Appendix G.

Based on our observations and interpretations of suspected LCP sample analytical results, as well as the previous documentation reviewed as outlined herein, the paints presented in the table in Appendix H were identified as LCPs that are anticipated to be impacted by the Project.

The following information is included for the identified LCP:

- paint colour
- substrate to which paint is applied
- location/approximate extent of the LCP within the building
- lead content of paint
- condition
- representative photographs, where available

In addition to those LCPs that will be impacted by the Project as indicated above, the following LCPs have been identified but are unlikely to require alteration or impacts during the Project:

- yellow paint on steel pipes on roof (previously identified)
- white, tan and light grey paint on exterior concrete foundation (previously identified)
- white paint on exterior tar/concrete foundation (previously identified)
- beige paint on metal Lennox air handling units on roof (identified through current assessment)
- green paint on metal vent casings on roof (identified through current assessment)



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4.2.2.2 Building Materials—Leachable Lead Content

Bulk samples of bulk building materials that are expected to be disposed of via landfill and that are coated with the herein identified LCPs that would require alteration during the Project were collected in a form presumed to be representative of waste generated during the Project and were submitted to EMSL for analysis of leachable lead content.

A summary of the sample types, locations and analytical results is presented in Table 1, below. A copy of the certificate of analysis provided by EMSL for the bulk painted building material samples submitted is included in Appendix G.

**Table 1 Painted Building Material Sample Collection and Lead Leachate Analysis Summary
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**

Sample Number	Paint Description and Application	Initial Result (Total Lead, ppm)	Leachate Result (mg/L)
L-02	White on wood soffit	34,500	23
L-03	Dark brown on wood trim	3,430–4,080	0.91
L-04	Grey on lower wood trim	3,700	0.86

NOTE:
Bold highlighted text indicates material that contains lead in a dispersible form such that its leachate contains greater than 5.0 mg/L lead.

As indicated above, analytical results indicate that the following materials contain lead in a dispersible form such that their leachates contain greater than 5.0 mg/L lead and will require segregation and special disposal during renovation.

- exterior white painted wood soffit material on the raised portion of the roof

4.2.3 Recommendations

When paints or other lead-containing equipment/materials within the subject building are disturbed and/or removed, ensure compliance with the following:

- exposure protection requirements of the COHSR and BC Reg. 296/97, including the provisions of the Lead Guideline
- transportation and disposal requirements of BC Reg. 63/88
- transportation requirements of the Federal Transportation of Dangerous Goods Regulation



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Corrective action or remedial work on paint applications containing any concentration of lead should be undertaken in a manner so as to avoid generating fine particulate matter or dust (i.e., avoid sanding). Airborne lead dust or fumes should not exceed the COHSR and BC Reg. 296/97 eight-hour occupational exposure limit (OEL) of 0.05 mg/m³ during the removal of paints and products containing any concentration of lead.

Ultimately, the employer is responsible to review the work tasks required and the ways in which materials (including those coated with paints that may contain lead in varying concentrations) will be impacted, as well as the individuals that will be present in the immediate vicinity of the work (i.e., potential for high-risk individuals) in order to determine the appropriate personal protective equipment (PPE—including respirators and protective clothing), containment and/or decontamination measures and work procedures that should be followed to protect workers from lead exposure.

4.2.3.1 Welding, Burning or Torch Cutting

Any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person. Development of such risk assessments and work practices will involve consideration of information including, but not limited to, the following:

- composition of the material to be disturbed
- lead content of the paint coating
- methods and tools to be used, including exhaust ventilation
- duration of the work/work shift
- training of the personnel conducting the task
- respiratory protection program in effect

4.3 POLYCHLORINATED BIPHENYLS

4.3.1 Methodology

A visual review for the presence of PCBs in electrical equipment was completed. Equipment that is generally suspected of containing PCBs includes lamp ballasts, transformers, hydraulic systems, compressors, switchgear and capacitors.

No sampling of dielectric fluids was undertaken as part of this assessment.

4.3.2 Findings

No suspected PCB-containing equipment was observed that is anticipated to be impacted by the Project.



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4.3.3 Recommendations

Should a material suspected to contain PCBs become uncovered during renovation activities (i.e., dielectric fluids, hydraulic fluids, fluorescent lamp ballasts of pre-1990 vintage), 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.

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

- transportation and disposal requirements of BC Reg. 63/88
- transportation requirements of the Federal Transportation of Dangerous Goods Regulation
- federal PCB Regulations (SOR/2008-273)

4.4 MOULD

4.4.1 Methodology

The presence of suspect visible mould was assessed through visual observations. Material observed with dark-coloured staining and/or a textured and discoloured appearance is described as “suspected mould”. Mould identified visually is defined as “suspected mould” unless it is confirmed as mould by laboratory analysis.

The scope of work and procedures utilized for the visual assessment were based on the recommendations for such provided in the documents listed below:

- Standard Construction Document CCA 82 *Mould Guidelines for the Canadian Construction Industry*, Canadian Construction Association, 2004 (referred to as CCA 82)
- *Guidelines on Assessment and Remediation of Fungi in Indoor Environment*, New York City Department of Health and Mental Hygiene, November 2008 (referred to as the NYC Guidelines)
- *Fungal Contamination in Public Buildings: Health Effects and Investigation Methods*, Federal-Provincial Committee on Environmental and Occupational Health, 2004 (referred to as the Health Canada Guide)
- *Indoor Air Quality in Office Buildings: A Technical Guide*, Report of the Federal-Provincial Advisory Committee on Environmental and Occupational Health, 1995 (referred to as the IAQ Guide)
- *Bioaerosols: Assessment and Control*, American Conference of Governmental Industrial Hygienists (ACGIH), 1999 (referred to as the ACGIH Report)
- *Field Guide for the Determination of Biological Contaminants in Environmental Samples*, AIHA, Second Edition 2005



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4.4.2 Findings

Suspect mould or moisture-impacted building materials that are anticipated to be impacted by the Project were not observed at the time of the assessment.

4.4.3 Recommendations

As no mould and/or moisture-impacted building materials that are anticipated to be impacted by the Project were observed within the subject building during the assessment, no recommendations have been provided.

4.5 MERCURY

4.5.1 Methodology

An assessment for equipment that is likely to contain mercury (such as thermostats, thermometers and fluorescent light tubes) was completed visually. Information on the type of equipment (i.e., gauges, switches, batteries, thermometers, etc.), model and serial numbers and quantities was recorded, where such information was available.

4.5.2 Findings

Items suspected to contain liquid mercury or mercury vapour that are anticipated to be impacted by the Project were not observed at the time of the assessment.

4.5.3 Recommendations

As no mercury-containing items that are anticipated to be impacted by the Project were observed within the subject building during the assessment, no recommendations have been provided.

4.6 OZONE DEPLETING SUBSTANCES

4.6.1 Methodology

An assessment for equipment or systems likely to contain ODSs (such as refrigeration/cooling equipment or fire suppression systems) was completed visually. Information on the type of equipment, manufacturer and type and quantity of refrigerants was recorded, where available.



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4.6.2 Findings

The following equipment was identified by labels to be ODS-containing:

- one rooftop Lennox HVAC unit labelled “ACU-2” (R-22, 4 lbs., 12 oz.)
- one rooftop Lennox HVAC unit labelled “ACU-4” (R-22, 4 lbs., 12 oz.)
- one rooftop Lennox HVAC unit labelled “ACU-5” (R-22, 7 lbs.)

The following equipment is suspected to be ODS-containing (labels were not accessible):

- one wall-mounted Friedrich A/C on exterior of the Data/LAN room (127)

Additional building-related refrigeration and/or air conditioning equipment observed on the roof was confirmed (by label information) to be charged with refrigerants that are not considered ODSs.

Although the above-noted equipment may not necessarily be replaced during the Project, it will likely require alteration or relocation.

The locations of the confirmed and suspect ODS-containing equipment are indicated in the floor plan drawings provided in Appendix B.

4.6.3 Recommendations

When refrigeration equipment that is suspected or confirmed to be ODS-containing is decommissioned, it should be emptied and inspected by licensed refrigeration technician (as defined in the Federal Halocarbon Regulations).

If ODS-containing equipment or ODS refrigerants are to be removed during renovation activities, ODSs must be handled, recycled, stored, transported and/or disposed of in accordance with the requirements of the following:

- British Columbia *Waste Management Act*—Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 387/99 as amended by BC Reg. 109/2002)
- Transportation requirements of the Federal Transportation of Dangerous Goods Regulation
- Federal Halocarbons Regulations

4.7 SILICA

4.7.1 Methodology

An assessment for the presence of silica was conducted visually. The presence of typical silica-containing building materials such as concrete, masonry, stone, terrazzo, refractory brick, gypsum, ceramic tile, ceiling tile and other items, was noted.



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4.7.2 Findings

Silica is expected to be present in the following, which were observed in various locations throughout, and are anticipated to be impacted by the Project.

- stucco
- asphalt and asphalt products containing rock or stone (e.g., roofing membrane)

4.7.3 Recommendations

When silica-containing materials within the subject building are to be disturbed and/or removed (e.g., coring through concrete slabs, demolition of stucco and asphalt materials), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and BC Reg. 296/97 (cristobalite and quartz—each 0.025 mg/m³). This would include, but not be limited to, the following:

- providing workers with respiratory protection
- wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
- providing workers with facilities to properly wash prior to exiting the work area



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5.0 CLOSURE

This report has been prepared for the sole benefit of Public Services and Procurement Canada on behalf of Transport Canada. Any use which a third party makes of this report, or any reliance on decisions based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professionals and technical staff in accordance with generally accepted engineering, scientific and occupational health and safety practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal advice.

The conclusions presented in this report represent the best technical judgment of Stantec Consulting Ltd. based on the data obtained from the work. The conclusions are based on the site conditions encountered by Stantec Consulting Ltd. at the time the work was performed at the specific assessment and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on building construction and conditions, weather, building usage and other factors. Due to the nature of the investigation and the limited data available, Stantec Consulting Ltd. cannot warrant against undiscovered environmental or health and safety liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

We trust that the above is satisfactory for your purposes at this time. Should you have any questions or concerns, or require additional information, please do not hesitate to contact the Stantec Project Manager at your convenience.

Regards,

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APPENDIX A
Hazardous Building Materials
Background Information, Health Effects
Information and Regulatory Framework

Appendix A HAZARDOUS BUILDING MATERIALS BACKGROUND INFORMATION, HEALTH EFFECTS INFORMATION AND REGULATORY FRAMEWORK

A.1 ASBESTOS

Asbestos is a naturally occurring form of fibrous silicate that is durable and flexible; has high thermal and tensile strength; is resistant to heat, chemical corrosion and friction; does not conduct electricity; and insulates well against condensation, heat and noise. Due to these properties, asbestos was used in over 3,000 commercial products, and it is estimated that approximately 70% of the asbestos that was used in North America was used in building materials.

In buildings, and among many other potential asbestos-containing materials, asbestos is typically found in plaster, mechanical insulation, gaskets, thermal insulation on pipes, refractory material, roofing felts, floor tiles, ceiling tiles and parging, heat resistant panels, incandescent light fixture reflector plates, and any other material requiring a high degree of durability or thermal resistance.

Asbestos-containing materials are grouped into two classifications, friable and non-friable materials. Friable ACMs are those that can easily be crumbled or broken apart by mere hand pressure. When these materials break apart asbestos fibres are then released into the atmosphere. Non-friable ACMs or “manufactured products” are materials that by the nature of their manufacturing/construction do not readily allow the release of asbestos fibres. These materials should not be cut or shaped with power tools, since this procedure may allow for the release of the asbestos fibres. Some materials or “manufactured products”, such as plaster, drywall and ceiling tiles that are considered to be non-friable in an undisturbed state can become friable when damaged or disturbed.

The common use of asbestos in various building materials started to decline as a result of changes in industry practices and/or legislation beginning in the mid-1970s. For example, the spray application of asbestos-containing fireproofing was prohibited in 1986. Although many types of ACMs were no longer in use by the 1990s, some ACMs, primarily non-friable materials such as asbestos cement products (e.g., pipes, shingles, wall panels) and sealants (e.g., roofing products, firestopping products, penetration sealants, pipe thread sealants) saw continued use. A material known as vermiculite, which was found to be asbestos-contaminated as a result of the co-occurrence of asbestos forms in the vermiculite mineral deposits, was used into the mid-1990s for insulation within attics, floor spaces or within masonry block wall systems. Asbestos was still used in selected building materials through the end of 2018 in Canada, when an official ban on the import, manufacture, sale, trade or use of asbestos-containing products was implemented.



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A.1.1 Health Effects

Undisturbed asbestos within building materials poses no health risks. Asbestos poses a risk when building materials containing asbestos are impacted, or disturbed, thereby releasing the asbestos fibres into the air.

Asbestos-related diseases are caused when suspended airborne asbestos fibres are inhaled and the fibres settle into various regions of the lungs and remain for extended periods. Once embedded in the lungs the asbestos fibres cause scarring within the lung tissue, ultimately leading to impaired lung function (asbestosis) and/or various cancers (lung cancer; mesothelioma). These asbestos-related diseases are irreversible and fatal. The risk of lung-related cancers is increased in individuals who smoke.

These asbestos-related diseases most often occur in individuals who have been exposed to high concentrations of airborne asbestos over a long period of time, though mesothelioma has been found in individuals with short-term exposures. Symptoms or the development of these asbestos-related diseases usually occur 10 to 25 years after exposure.

A.1.2 Regulatory Framework

Asbestos is included in the Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR) and British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97). Included in both regulatory instruments are provisions for the general duties of employers, requirements for health assessments, training and project notification. There are also sections that will also apply to abatement projects, depending on the work procedures and specific work site hazards.

The COHSR and BC Reg. 296/97 also established an 8-hour occupational exposure limit (OEL) for asbestos (all forms) to be 0.1 fibre/cubic centimetre.

The 2017 WorkSafeBC publication *Safe Work Practices for Handling Asbestos* (Asbestos Guide) is used by Occupational Health and Safety officers as a guide when reviewing abatement work practices and employer codes of practice, and generally meets the requirements of the COHSR.

The Asbestos Guide also provides significant additional background information pertaining to asbestos, along with details on health effects and other applicable legislation within the province of British Columbia (e.g., the federal *Hazardous Products Act*, the BC Building Code and waste disposal regulations).

According to the COHSR, ACM means:

- Any article that is manufactured and contains 1% or more asbestos (by weight) at the time of manufacture, or any material that contains 1% or more asbestos when tested in accordance with accepted methods.

According to the current version of BC Reg. 296/97, asbestos-containing material (ACM) means any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos.



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Disposal of asbestos waste is governed by the British Columbia Hazardous Waste Regulation (BC Reg. 63/88). The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of asbestos waste in British Columbia. In general, and for transportation and disposal, the waste must be placed in a double sealed container, properly labeled, free of cuts, tears or punctures and disposed of at a licensed waste station which has been properly notified of the presence of asbestos waste.

A.1.3 Condition, Accessibility and Action Matrix for Identified ACMs

When conducting ACM assessments, it is important to note the condition of the ACMs identified. Protocols for assessing condition and accessibility of identified ACMs to determine recommended actions are generally based on the PSPC AMS, the provisions of the RCMP E Division Asbestos Management Plan (AMP), as well as industry standards of practice, as summarized in the following sections.

A.1.4 Assessment of Condition

Friable ACMs other than Mechanical Insulation

In evaluating the condition of friable ACMs other than mechanical insulation (e.g., spray-applied as fireproofing, texture, decorative or acoustic finishes), the following criteria apply:

Good

- Surface of material shows no significant signs of damage, deterioration or delamination. Up to one percent visible damage to surface is allowed within range of GOOD. Evaluation of sprayed fireproofing requires the Assessor to be familiar with the irregular surface texture typical of sprayed asbestos products. GOOD condition includes un-encapsulated or un-painted fireproofing or texture finishes, where no delamination or damage is observed, and encapsulated fireproofing or texture finishes where the encapsulation has been applied after the damage or fallout occurred.

Poor

- Sprayed materials show signs of damage, delamination or deterioration. More than one percent damage to surface of ACM spray.

In observation areas, where damage exists in isolated locations, both GOOD and POOR condition may be reported. The extent or percentage of each condition will be recorded on the Assessor's assessment form.

Fair condition is not utilized or considered as a valid criterion in the evaluation of sprayed fireproofing, sprayed insulation, or texture coat finishes.



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The evaluation of ACM spray-applied as fireproofing, non-mechanical thermal insulation, or texture, decorative or acoustic finishes, which are present above ceilings, may be limited by the number of observations made, and by building components such as ducts or full height walls that obstruct the above ceiling observations. Persons entering the ceiling area are advised to be watchful for ACM DEBRIS prior to accessing or working above ceilings in areas of building with ACM, regardless of the reported condition.

Mechanical Insulation

In evaluating the condition of mechanical insulation (on boilers, breaching, ductwork, piping, tanks, equipment, etc.) the following criteria are used:

Good

- Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration. No insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e., scuffs or stains), but the jacketing is not penetrated.

Fair

- Minor penetration damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination) or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation ranges should be minor to none.

Poor

- Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed and significant areas have been dislodged. Damage cannot be readily repaired. The evaluation of mechanical insulation may be limited by the number of observations made and building components such as ducts or full height walls that obstruct observations. In these circumstances, it is not possible to observe each foot of mechanical insulation from all angles.

Non-Friable and Potentially Friable Materials

Non-friable materials generally have little potential to release airborne fibres, even when damaged by mechanical breakage. However, some non-friable materials, i.e., exterior asbestos cement products, may have deteriorated so that the binder no longer effectively contains the asbestos fibres. In such cases of significantly deteriorated non-friable material, the material will be treated as a friable product, and evaluated per the above criteria.

Asbestos-Containing Material Debris

Debris from Friable ACM

The presence of fallen ACM is noted separately from the presumed friable ACM source (sprayed fireproofing, thermal insulation, texture, decorative or acoustic finishes or mechanical insulation) and is referred to as debris.



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Debris from Damaged Non-Friable ACM

The presence of fallen ACM, from damaged non-friable ACM, is reported separately from the non-friable ACM source. Only fallen non-friable ACM that has become friable, is reported as debris.

A.1.5 Evaluation of Accessibility

The accessibility of building materials known or suspected of being ACM is rated according to the following criteria:

Access (A)

Areas of the building within reach of all building users. Includes areas such as gymnasiums, workshops, and storage areas where activities of the building users may result in disturbance of ACM not normally within reach from floor level.

Access (B)

Frequently entered maintenance areas within reach of maintenance staff, without the need for a ladder. Includes: frequently entered pipe chases, tunnels and service areas or areas within reach from a fixed ladder or catwalk, i.e., tops of equipment, mezzanines.

Access (C) Exposed

Areas of the building above 8'0" where use of a ladder is required to reach the ACM. Only refers to ACM materials that are exposed to view, from the floor or ladder, without removing or opening other building components such as ceiling tiles, or service access doors or hatches. Does not include infrequently accessed service areas of the building.

Access (C) Concealed

Areas of the building which require the removal of a building component, including lay-in ceilings and access panels into solid ceiling systems. Includes rarely entered crawl spaces, attic spaces, etc. Observations are limited to the extent visible from the access points.

Access (D)

Areas of the building behind inaccessible solid ceiling systems, walls, or mechanical equipment, etc. where demolition of the ceiling, wall or equipment, etc., is required to reach the ACM. Evaluation of the condition and extent of ACM is limited or impossible, depending on the assessor's ability to visually examine the materials in Access D.



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A.1.6 Action Matrix

Standard asbestos management protocols typically require the following responses:

- Immediate clean-up of debris that is likely to be disturbed.
- The removal, repair or enclosure of friable ACM in **POOR** or **FAIR** condition where continued deterioration will result in debris that is likely to be disturbed.

The following factors are typically considered in making site-specific recommendations for compliance with applicable regulations, and for the practical implementation of asbestos management:

1. ACM in **POOR** condition is not routinely repairable.
 - a. If an abatement action is necessary, removal is the recommended action (enclosure is a viable option in unusual circumstances).
2. Mechanical insulation in **FAIR** condition will be repaired or removed based on the following general recommendations, applied on a case-by-case basis.
 - a. Repair ACM mechanical insulation found in **FAIR** condition in ACCESS (B) or ACCESS (C) EXPOSED areas.
 - b. Remove ACM mechanical insulation found in **FAIR** condition in ACCESS (B) and ACCESS (C) EXPOSED areas, where future damage to the ACM is likely to occur.
 - c. Remove ACM mechanical insulation found in **FAIR** condition in ACCESS (A) to eliminate the potential for re-damaging ACM by all building users.
3. ACM in **GOOD** condition present in ACCESS (A) can be managed by surveillance, as long as it is not disturbed by future renovation, maintenance or demolition. Proactive removal of the ACM in ACCESS (A) will be considered where damage is possible by ongoing occupant activity (accidental or intentional).
4. Non-friable or manufactured products are considered in the action matrix as follows:
 - a. Non-friable and manufactured products reported in **POOR** condition, or friable debris resulting from the deterioration of non-friable ACM, are treated as friable materials and the appropriate Action, depending on accessibility, is determined from the Action Matrix for friable ACM.
 - b. For non-friable or manufactured products reported in **GOOD** condition, Action 7 (surveillance) is recommended regardless of accessibility.
5. Remove all ACM from a particular area where small quantities of asbestos are present and removal will negate the need for the use of the Asbestos Management Program in that area.

The Action Matrix provided below establishes the recommended asbestos control action. The ACTIONS are described in full following the matrix.



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Table A.1 Action Matrix

Access	Friable ACM Condition			Debris
	Good	Fair	Poor	
(A)	ACTION 5/7 ¹	ACTION 5/6 ²	ACTION 3	ACTION 1
(B)	ACTION 7	ACTION 6/5 ³	ACTION 3	ACTION 1
(C) exposed	ACTION 7	ACTION 6	ACTION 4	ACTION 2
(C) concealed	ACTION 7	ACTION 7	ACTION 4	ACTION 2
(D)	ACTION 7	ACTION 7	ACTION 7	ACTION 7

NOTES:

- ¹ If material in ACCESS (A)/GOOD condition is not removed ACTION 7 is required.
- ² If material in ACCESS (A)/FAIR condition is not removed ACTION 6 is required.
- ³ Remove ACM in ACCESS (B)/FAIR condition if ACM is likely to be disturbed.

Action Descriptions

ACTION 1 Immediate Clean-up of Debris that is Likely to be Disturbed

Restrict access that is likely to cause a disturbance of the **ACM DEBRIS** and contact an approved asbestos abatement contractor to clean up **ACM DEBRIS** immediately, utilizing correct asbestos procedures. This action is required for compliance with regulatory requirements. The surveyor should immediately notify the Property Manager of this condition.

ACTION 2 Entry into Areas with ACM Debris—Moderate Risk Precautions

At locations where **ACM DEBRIS** can be isolated in lieu of removal or cleaned up, use appropriate means to limit entry to the area. Restrict access to the area to approved asbestos abatement contractor personnel. The precautions will be required until the **ACM DEBRIS** has been cleaned up, and the source of the **DEBRIS** has been stabilized or removed.

ACTION 3 ACM Removal Required for Compliance

Contact an approved asbestos abatement contractor to remove **ACM** for compliance with regulatory requirements, utilizing asbestos procedures appropriate to the scope of the removal work.

ACTION 4 Access into Areas Where ACM is Present and Likely to be Disturbed by Access—Moderate Risk Precautions

Assessment and/or contractor personnel will use Moderate Risk asbestos precautions when entry or access into an area is likely to disturb the **ACM**. ACTION 4 must be used until the **ACM** is removed (Use ACTION 1 or 2 if debris is present).



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ACTION 5 Proactive ACM Removal

Retain an approved asbestos abatement contractor to remove **ACM** in lieu of repair, or at locations where the presence of asbestos in **GOOD** condition is not desirable.

ACTION 6 ACM Repair

Retain an approved asbestos abatement contractor to repair **ACM** found in **FAIR** condition, and not likely to be damaged again or disturbed by normal use of the area or room. Upon completion of the repair work, treat **ACM** as material in **GOOD** condition and implement **ACTION 7**. If **ACM** is likely to be damaged or disturbed, during normal use of the area or room, implement **ACTION 5**.

ACTION 7 Routine Surveillance

Institute routine surveillance of the **ACM**. Trained workers or contractors must use appropriate asbestos precautions (Low Risk, Moderate Risk or High Risk) during disturbance of the remaining **ACM**.

A.2 LEAD

Lead may be used in its pure metallic form or combined chemically with other elements to form lead compounds. Metallic lead is used to make products such as electric storage batteries, ammunition, lead solder, radiation shields, pipes, and sheaths for electric cables. Metallic lead is sometimes combined with other metals such as copper, tin and antimony as lead alloys for use in the manufacture of a variety of metal products.

Organic lead compounds contain a lead atom covalently bonded to carbon. Common examples of organic lead compounds include lead “soaps” such as lead oleates, high pressure lubricants, and anti-knock agents in gasoline.

Inorganic lead compounds (or lead salts) result when lead is combined with an element other than carbon. Examples are lead oxide, lead chromate, lead carbonate and lead nitrate. Inorganic lead compounds may occur as solids or in solutions, and are used in insecticides, pigments, paints, frits, glasses, plastics, and rubber compounds.

Lead is commonly found in buildings in items such as the solder used on copper domestic pipes; the caulking on bell fittings of cast iron drainage pipes; electrical equipment/wiring; batteries (e.g., emergency exit signage batteries); lead sheeting (e.g., x-ray rooms); vent and pipe flashings; and paints and ceramic tile glazes.



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A.2.1 Health Effects

Elemental lead and inorganic lead compounds are absorbed through ingestion or inhalation and can incorporate into the bone marrow, nerve tissue, brain, and kidneys. In children, symptoms of lead poisoning can include headaches, irritability, abdominal pain, vomiting, anemia, weight loss, poor attention span, noticeable learning difficulty, slowed speech development, and hyperactivity. In adults, symptoms of lead poisoning can include pain, numbness or tingling of the extremities, muscular weakness, headache, abdominal pain, memory loss, unsteady gait, pale skin, weight loss, vomiting, irritability, and anemia. Although adults are susceptible to the toxic effects of lead, children are at high risk due to the nature of a child's activities that involve the introduction of non-food items into their bodies.

Excessive airborne lead and surface contamination can be transferred to employees' hands and may result in lead ingestion. Therefore, work practices intended to minimize surface lead concentrations, such as frequent cleaning of work surfaces should be included in an overall lead exposure control plan.

A.2.2 Regulatory Framework

In the past, the United States Department of Housing and Urban Development (HUD) set a criteria of lead-based paint as 0.5% lead (by weight) or 5,000 parts per million (ppm) for evaluating whether lead is a hazard in a residential setting.

In Canada, the Surface Coating Materials Regulations (SOR/2005-109) under the federal *Hazardous Products Act* provides a concentration of lead that must not be exceeded in surface coatings that are presently sold in this country. This value has recently been reduced from 600 ppm (2005) to 90 ppm (2010). However, it is important to note that this regulation does not comment on the potential occupational exposure if the material is disturbed.

Under the COHSR and BC Reg. 296/97, a regulatory limit has been established for occupational exposure to airborne lead that may be present in a workplace. The OEL for airborne lead dust or fumes per both regulatory instruments should not exceed the TWA value of 0.05 milligram per cubic metre of air (mg/m^3). The OEL represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.

With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, the 2011 WorkSafeBC manual titled *Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry*, indicates the following:

- Improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the exposure limit.
 - This potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan.



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- Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children.
 - Any risk assessment should include for the presence of high risk individuals within the workplace.

In addition to the above, the 2017 WorkSafeBC publication *Safe Work Practices for Handling Lead* (Lead Guideline) indicates the following:

Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.

Work procedures that can be used to assist in protecting workers and adjacent work areas from exposure to lead during disturbance activities can also be found in this document.

According to the British Columbia Hazardous Waste Regulation (BC Reg. 63/88), lead waste may be considered a toxic leachate (and require special disposal) if lead is in a dispersible form and its leachate contains greater than 5.0 milligrams per litre (mg/L) lead.

The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of lead waste in British Columbia.

A.2.3 Condition Evaluation for Lead-Containing Paints

When evaluating the condition of LCPs, an attempt should be made to determine whether the deterioration is due to a moisture problem or some other existing building deficiency.

“**Poor**” surfaces are considered to be a hazard and should be corrected. “**Fair**” surfaces should be repaired but are not yet considered to be a hazard; if not repaired, they should be monitored frequently. “**Good/intact**” surfaces should be monitored to ensure that they remain in a nonhazardous condition.

In addition, the presence of paint debris must be considered in evaluating condition. Given the variety of paint uses, there are many applications that can have a tendency for the paint to “wear” from the surface slowly, over an extended period of time. Conditions where paint has worn from a surface are worth noting for maintenance discussions (i.e., related to re-coating the surface should, for example, the coating provide weather protection), however, in the absence of loose paint chip debris/dust, such conditions would not represent a potential exposure situation related to lead.

The condition evaluation criteria for LCPs are summarized in Table A.2, below.



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Table A.2 Lead-Containing Paint Condition Categories

Type of Building Component ¹	Total Area of Deteriorated Paint on Each Component		
	Good/Intact	Fair ²	Poor ³
Exterior components with large surface areas	Entire surface is intact.	Less than or equal to 10 square feet	More than 10 square feet
Interior components with large surface areas (walls, ceilings, floors, doors)	Entire surface is intact.	Less than or equal to 2 square feet	More than 2 square feet
Interior and exterior components with small surface areas (window sills, baseboards, soffits, trim)	Entire surface is intact.	Less than or equal to 10% of the total surface area of the component	More than 10% of the total surface area of the component
NOTES:			
¹ Building component in this table refers to each individual component or side of building, not the combined surface area of all similar components in a room (e.g., a wall with 1 square foot of deteriorated paint is in “fair” condition, even if the other three walls in a room are intact).			
² Surfaces in “fair” condition should be repaired and/or monitored but are not considered to be “lead-containing paint hazards”.			
³ Surfaces in “poor” condition are considered to be “lead-containing paint hazards” and should be addressed through abatement or interim controls.			

A.3 POLYCHLORINATED BIPHENYLS (PCBS)

PCBs are man-made toxic chemicals whose physical and chemical properties produce the following attributes: fire resistance, low electrical conductivity, high resistance to thermal breakdown, high chemical stability and resistance to oxidants and other chemical.

PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. In fluorescent fixtures, PCBs were usually found within the small capacitors inside the ballast that controls the lamp. The Federal Chlorobiphenyls Regulation, SOR/91-152, prohibited the use of PCBs in electrical equipment manufactured after July 1, 1980. Stocks of items such as ballasts containing PCBs may have been used into the early or mid-1980s.

A.3.1 Health Effects

PCBs are insoluble in water; however, they readily dissolve in fats and other organic compounds. It is these attributes and fat-solubility that allow PCBs to persist in the environment and bio-accumulate in humans and animals. Exposure to PCBs can affect the immune system, reproductive system, nervous system and endocrine system. In humans, PCBs are potentially cancer-causing.



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A.3.2 Regulatory Framework

As of September 5, 2008, under subsection 93(1) of the Canadian *Environmental Protection Act*, (CEPA), Federal PCB regulations were published by the Canada Gazette Part II (SOR/2008-273) that imposed specific deadlines for the elimination of all PCBs in concentrations at or above 50 milligrams/kilogram (mg/kg). This regulation required the elimination of all PCBs and PCB-containing materials currently in-use and in storage and limited the period of time PCB materials could be stored before being eliminated. Other aspects of the regulation govern the labelling and reporting of stored PCB materials and equipment as well as improved practices for the management of PCBs that remain in use (i.e., those with PCB concentrations less than 50 mg/kg) until their eventual elimination.

Under SOR/2008-273, the following end-of-use dates were established:

- December 31, 2009
 - equipment containing PCBs in a concentration of 500 mg/kg or more
 - equipment containing PCBs in a concentration of at least 50 mg/kg but less than 500 mg/kg when located in sensitive locations (i.e., drinking-water treatment plant, food or feed processing plant, child care facility, preschool, primary or secondary school, hospital, or senior citizen care facility or the property on which the plant or facility is located, within 100 m of it)
- December 31, 2014
 - certain specified equipment not replaced by the 2009 deadline due to technical constraints for engineered-to-order equipment or if the facility is scheduled for permanent closure before 2014
- December 31, 2025
 - equipment containing PCBs in a concentration of at least 50 mg/kg but less than 500 mg/kg when located in non-sensitive locations

In addition to the above, a maximum storage period of one year is allowed for PCBs and products that contain PCBs at each of the following non-sensitive locations:

- owner's PCB storage site
- PCB storage site of an authorized facility for decontamination or of an authorized transfer site
- PCB storage site of an authorized destruction facility



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For British Columbia, according to the British Columbia Hazardous Waste Regulation (BC Reg. 63/88):

- PCB wastes are defined as: PCB liquid, PCB solid, and PCB equipment that have been taken out of service for the purpose of treatment, recycling, reuse, or disposal, or for the purpose of storage prior to treatment, recycling, reuse, or disposal.
 - “PCB liquid” means any liquid containing more than 50 parts per million (ppm) by weight of PCB.
 - “PCB solid” means any material or substance other than PCB liquid that contains or is contaminated with chlorobiphenyls at a concentration greater than 50 ppm by weight of chlorobiphenyls.
 - “PCB Equipment” means any manufactured item that contains or is contaminated with a PCB liquid or PCB solid is PCB equipment. While items of PCB equipment are often electrical components such as transformers or capacitors, the definition includes other items such as contaminated drums and containers.
 - o NOTE: An item of equipment from which PCB liquid or PCB solid has been removed is still PCB equipment until it has been decontaminated by an approved protocol. This is because the removal is a treatment process and the equipment, until decontaminated, is a residue from the treatment.

In British Columbia, PCB equipment becomes PCB wastes as soon as it is removed from service. This is the case even if the intent is to treat, recycle, or reuse the equipment.

When PCB wastes are stored in British Columbia, the full requirements of BC Reg. 63/88 apply to:

- 1.0 kg or more of pure PCB
- 100 L or more of any liquid containing more than 50 ppm of PCB
- 100 kg or more of any material other than a liquid, contaminated with more than 50 ppm of PCB

These amounts are the total of all amounts at a single location owned or controlled by the same person. They include PCB equipment. BC Reg. 63/88 also provides packaging requirements for storage, labeling requirements, waste destruction requirements, and references SOR/2008-273, indicating

NOTE: The federal PCB Regulations also apply to stored PCBs and have strict maximum allowable storage periods which would prohibit provisions in [BC Reg 63/88] related to storage prior to 1 April 1992. In event of a conflict between [BC Reg 63/88] and [SOR/2008-273], follow [SOR/2008-273].

The Federal Transportation of Dangerous Goods Regulation sets out the requirements for the proper transport of PCB waste across provincial boundaries.



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In British Columbia, a manifest issued by the Ministry of Environment (or equivalent federal document) must be used for hazardous wastes shipped from sites in British Columbia. A manifest must be used to transport:

- 5 kg or more of PCB solids
- 5 L or more of PCB liquids
- an amount of a PCB solid or PCB liquid containing more than 500 g of PCB within BC
- 500 g or more of solids, liquids, or mixtures of these containing 50 mg/kg of PCB outside of BC

A.4 MOULD

Mould can be found everywhere in the outside environment—on plants, in soil and on dead and decaying matter (i.e., dead leaves). Mould requires two main conditions in order to grow—a source of food (a substrate typically comprised of cellulose) and water. Sources of food for mould are plentiful in outdoor and indoor environments; however, it is the presence of water in an indoor environment that will determine mould growth. The source of water can be a result of a water pipe leak or even excess condensation. Thus, the key to controlling mould indoors is to control the presence of water.

The removal of building materials impacted by mould growth may require workers with specific training and experience using work procedures that have been developed to protect workers and work areas from exposure to elevated concentrations of airborne mould.

A.4.1 Health Effects

There are a number of documented cases of health problems related to exposure to indoor fungi. Both high-level, short-term exposures and lower-level, long-term exposures can result in illness. The most common symptoms from exposure to mould in indoor environments are runny nose, eye irritation, cough, congestion, aggravation of asthma, headache, flu-like symptoms, fatigue, and skin rash. People with suppressed immune systems may be susceptible to fungal infections as a result of exposure to indoor moulds.

People who are exposed to mould growth on building materials will not necessarily exhibit adverse health effects. However, the mould must still be removed. Humans are at risk from indoor mould when fungal spores, fragments or metabolites are released into the air and inhaled or physically contacted (dermal exposure).

Not everyone experiences allergic reaction; the susceptibility to exposure varies with the individual's genetic predisposition, age, state of health, and concurrent exposures. For these reasons, and because the measurement of exposure is not standardized and biological markers of exposure to fungi are largely unknown, it is not possible to establish "safe" or "unsafe" levels of exposure. However, federal and provincial policies have been written to minimize mould exposure and the elimination of mould indoors.



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A.4.2 Susceptibility to Mould Exposure

People's reaction to mould exposure is quite varied, and although anyone can be affected, some people may be more susceptible and at greater risk, including:

- infants and children
- elderly
- pregnant women
- individuals with respiratory conditions or allergies and asthma
- persons with weakened immune system (e.g., chemotherapy patients, organ or bone marrow transplant recipients, and people with HIV infections or autoimmune diseases)

People with specific health concerns should consult their doctor if concerned about mould exposure. Symptoms that may appear to stem from mould exposure may be due to other causes such as bacterial or viral infections or other allergies.

A.4.3 Regulatory Framework

At present, there are no specific laws or regulations governing acceptable levels of mould in buildings. The lack of specific regulatory standards is due in part to an inability to establish exposure-response relationships. Variation in individual susceptibility, limitations in sampling and analytical techniques, and the vast number of fungal agents and their products make it difficult to establish safe levels of exposure for all individuals. With a lack of defined exposure criteria, current Health Canada and other agency guidelines on the assessment and control of mould contamination in public buildings are largely based on prudent avoidance (i.e., remove any indoor growth or amplification site of mould, regardless of the concentration of moulds or their products in the indoor environment).

Although there are currently no regulations in Canada pertaining specifically to mould in buildings, occupational health and safety regulations typically require employers to take every precaution reasonable in the circumstances for the protection of workers. For example, BC Reg. 296/97 indicates the following:

- Section 4.79(1):
 - Employer must ensure that the indoor air quality is investigated when
 - a) complaints are reported
- Section 4.79(2):
 - Air quality investigation must include
 - c) sampling for airborne contaminants suspected to be present in concentrations associated with the reported complaints



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The WorkSafeBC Guideline for Part 4 of BC Reg. 296/97 discusses the application of the Regulation to workplaces with mould showing on exposed or hidden surfaces, or where mould may be a factor in complaints regarding indoor air quality. The guideline provides information for investigating indoor air quality complaints with respect to mould contamination, including information on sampling for the presence of moulds in buildings. Information is also provided on possible health effects and for cleanup personnel involved in the remediation of buildings damaged by water and mould.

Several additional guidelines and other resources describe procedures for the investigation and remediation of mould. The following documents indicate that mould observed in occupied building should be remediated in accordance with these procedures:

- Environmental Abatement Council of Ontario's (EACO) *Mould Abatement Guidelines*, 2010—Edition 2
- *Mould Guidelines for The Canadian Construction Industry*, Canadian Construction Association—82, 2004
- *Guidelines on Assessment and Remediation of Fungi in Indoor Environment*, New York City Department of Health and Mental Hygiene, November 2008
- *Bioaerosols: Assessment and Control*, ACGIH 1999
- *Fungal Contamination in Public Buildings: Health Effects and Investigation Methods*, Federal-Provincial Committee on Environmental and Occupational Health 2004
- *Field Guide for the Determination of Biological Contaminants in Environmental Samples*, AIHA 1996
- *Clean-Up Procedures for Mould in Houses*, Canada Mortgage and Housing Corporation (CMHC) 2004

A.5 MERCURY

Mercury is commonly found in buildings as mercury vapour lighting, thermostats/thermometers with mercury-containing glass ampoules, electrical switches and can also be found in minor amounts in fluorescent lamp tubes and vapour bulbs and may be present in stable forms in adhesives. If mercury is exposed to the air, odourless vapours are formed.

A.5.1 Health Effects

Routes of exposure for mercury and mercury compounds include inhalation, ingestion, skin and/or eye contact. Mercury is hazardous if it is inhaled or absorbed through the skin, therefore exposure controls (including both respiratory protection and skin protection) are important to consider.

Elemental (metallic) mercury most often causes health effects through inhalation of its vapour, which can be absorbed through the lungs. This kind of exposure can result when elemental mercury is spilled (or products that contain elemental mercury break) and the mercury is exposed to the air. Vapour concentrations can vary especially in warm or poorly-ventilated indoor spaces where the airborne concentration can exceed the permissible exposure limit (provincially set).



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Chronic mercury “poisoning” can be caused by long-term exposure to low airborne concentrations (or low levels) of mercury. Symptoms or effects of mercury exposure include: tremors, emotional changes (e.g., mood swings, nervousness, irritability, etc.), neuromuscular effects (e.g., muscular weakness, twitching), mental changes/disturbances, digestive disturbances, headaches, insomnia, and changes in nervous response.

Factors that determine the severity of the health effects from mercury exposure include the following:

- chemical form of mercury (e.g., elemental, methylmercury, inorganic and organic)
- dose
- age of individual exposed
- duration of exposure
- route of exposure—as listed above
- health of individual exposed

A.5.2 Regulatory Framework

In Canada, the Surface Coating Materials Regulations (SOR/2005-109) under the federal *Hazardous Products Act* provides a concentration of mercury that must not be exceeded in surface coatings that are presently sold in this country. This value was set at 10 ppm in 2005. However, it is important to note that there is not a direct correlation between the concentration of mercury in a material to the potential occupational exposure if the material is disturbed.

Exposure to mercury is regulated by the COHSR and BC Reg. 296/97. The regulated occupational exposure limit for airborne mercury according to both regulatory instruments is 0.025 mg/m³ (eight-hour TWA).

Mercury disposal should be through a scrap dealer (elemental mercury), recycling firm for mercury vapour and returned to the manufacturer for light tubes and fixtures. Disposal of mercury waste is governed by BC Reg. 63/88.

The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of mercury waste in British Columbia.

A.6 OZONE-DEPLETING SUBSTANCES

Ozone-depleting substances (ODSs) are chemical agents known as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) used in various refrigeration equipment including air-conditioning, heat pump, refrigeration or freezer units. They have also been used in solvents, as aerosol additives in the production of foam insulation and in fire extinguishing equipment.



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A.6.1 Health Effects

Health effects are not typically related to exposure to ODSs directly, but to the consequences of ODS release to the atmosphere, subsequent degradation of the earth's ozone layer, and implications associated with increased UVB light exposure.

A.6.2 Regulatory Framework

ODSs are regulated in British Columbia by the British Columbia *Waste Management Act*—Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 387/99 as amended by BC Reg. 109/2002).

On federal land, aboriginal land and federal works, buildings and undertakings, the Federal Halocarbon Regulation 2003 (SOR/2003-289) applies. All other buildings and uses of refrigerants and other agents are under the Ozone-Depleting Substances Regulations 1998 (SOR/99-7), under CEPA. The regulations prohibit the release of halocarbons contained in refrigeration systems, air conditioning systems, fire extinguishers (except to fight a fire that is not a fire caused for training purposes) or containers or equipment used in the re-use, recycling, reclamation or storage of a halocarbon.

The regulations also impose restrictions on the servicing and dismantling, disposing of or decommissioning of any system containing halocarbons and requires the recovery of halocarbons into an appropriate container by a certified individual. The regulation also details an owner's record-keeping obligations.

If ODS-containing materials are to be removed and disposed of, all ODSs must be handled, recycled, stored, and/or disposed of in accordance with the requirements of BC Reg. 63/88.

The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of ODS waste in British Columbia.

A.7 SILICA

Silica is a scientific name that refers to a mineral group made up of silicon and oxygen. It is the crystalline form of silica that is of concern when considering health effects. Crystalline silica occurs in several forms including quartz, cristobalite and tridymite. Silica's many uses include sand in golf courses and playgrounds, sandblasting abrasives, glass, ceramics, building materials (concrete, grout, bricks, blocks, asphalt, acoustical tiles, floor tiles, and plaster), electronic components.



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Dust containing respirable crystalline silica is produced during construction-related activities such as the following:

- demolition
- masonry, bricklaying and/or stone setting
- rock drilling
- repair and/or finishing of concrete materials
- abrasive blasting
- dry sweeping
- quarrying and mining

A.7.1 Health Effects

Crystalline silica dust particles, which are small enough to be inhaled into the lungs (respirable size), can cause a number of health problems. As with asbestos, silica within building materials poses no threat to human health if left undisturbed.

Exposure to crystalline silica airborne dust may cause scarring of the lungs with coughing and shortness of breath—also known as “silicosis”, a form of disabling, progressive, and sometimes fatal pulmonary fibrosis.

A.7.2 Regulatory Framework

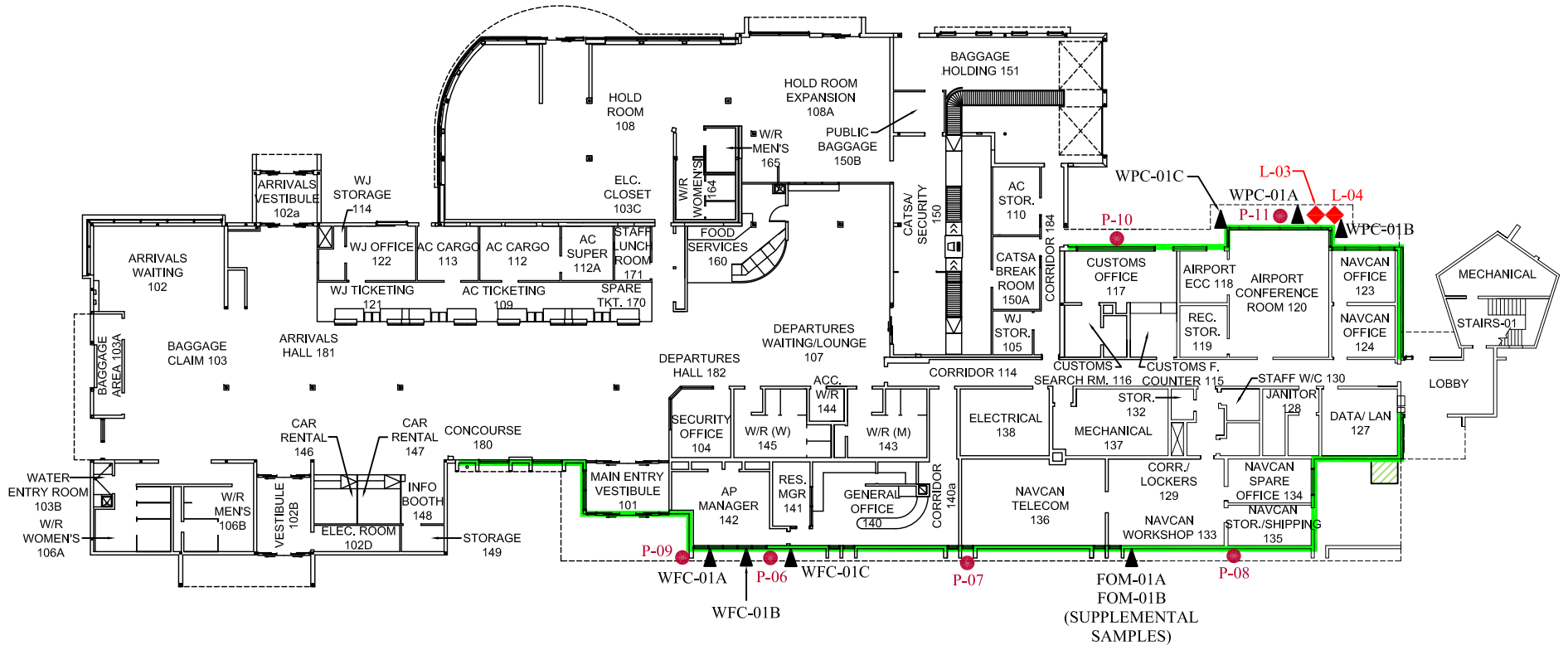
Regulations pertaining to silica are provided in BC Reg. 296/97. Included are general provisions (minimizing release; keeping worksite clear of unnecessary accumulations; ensuring methods for decontamination prevent generation of airborne silica), provisions for “restricted areas” (where there is a reasonable chance that the airborne concentration of silica exceeds or may exceed the occupational exposure limit), provisions for use in abrasive blasting, and provisions for health assessments for workers exposed to silica.

BC Reg. 296/97 and the COHSR also establish the eight-hour OEL for silica to be 0.025 mg/m³ for each cristobalite and quartz.



APPENDIX B

Floor Plans



MAIN LEVEL

LEGEND

- ▲ ASBESTOS BULK SAMPLE
- LEAD PAINT CHIP SAMPLE
- ◆ LEAD LEACHATE SAMPLE
- ▨ EQUIPMENT SUSPECTED TO CONTAIN OZONE DEPLETING SUBSTANCES
- ▭ AREA ASSESSED

- NOTES:**
1. TEXTURE COAT/STUCCO ON EXTERIOR WALLS AND SOFFITS IS ASBESTOS-CONTAINING THROUGHOUT MAIN FLOOR.
 2. GREY WINDOW PUTTY APPLIED BETWEEN PANE AND FRAME ON INTERIOR THROUGHOUT IS ASBESTOS CONTAINING.
 3. GREY WINDOW FRAME CAULKING APPLIED BETWEEN FRAME AND WALL ON EXTERIOR THROUGHOUT IS ASBESTOS-CONTAINING.
 4. 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

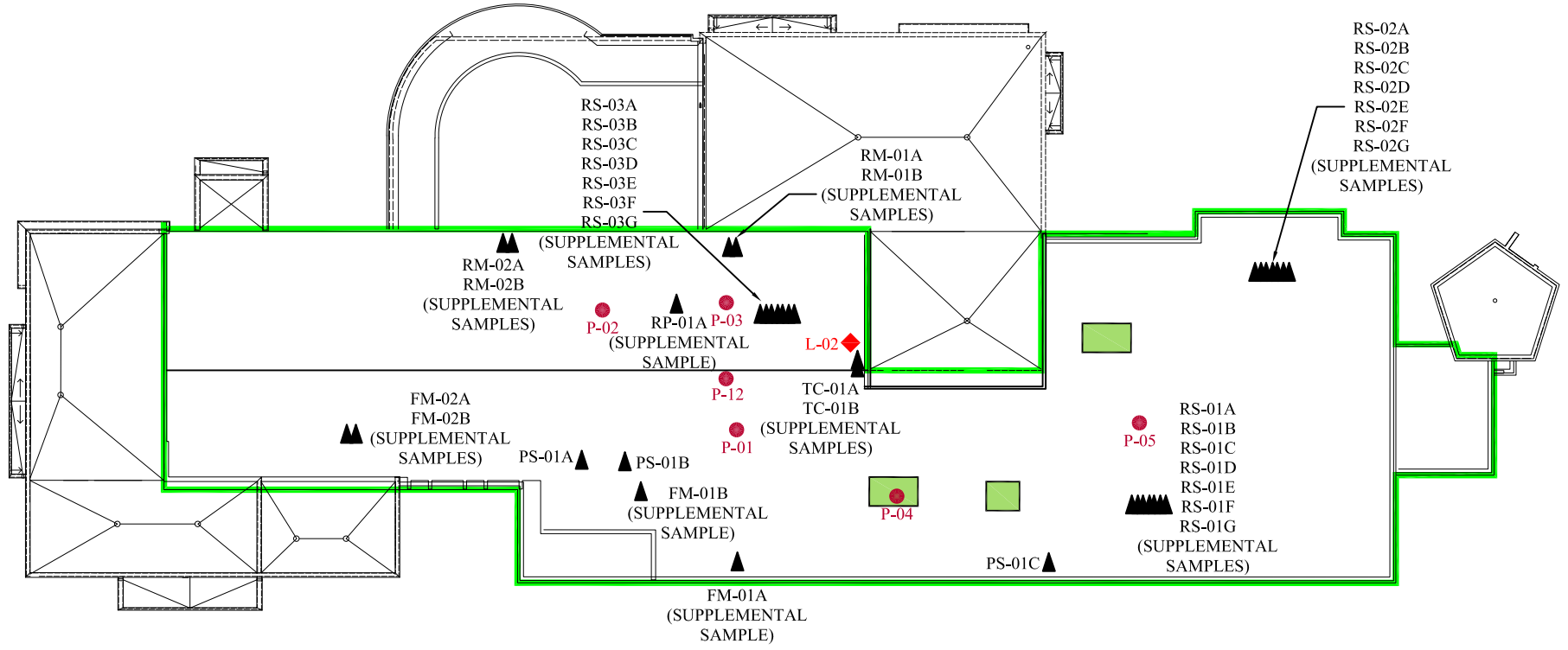
PENTICTON REGIONAL AIRPORT - 3000 AIRPORT ROAD, PENTICTON, BC

Client: PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC) ON BEHALF OF TRANSPORT CANADA (TC)

Project No.: 123221854	1
Scale: N.T.S.	
Date: 21/05/28	
Dwn. By: CD CS/DM SL2021050271	
App'd By: TW	

Dwg. No.:





ROOF

LEGEND

- ▲ BULK SAMPLE
- PAINT CHIP SAMPLE
- ◆ LEAD LEACHATE SAMPLE
- EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES
- AREA ASSESSED

NOTES: 1. GREY WINDOW PUTTY APPLIED BETWEEN PANE AND FRAME ON INTERIOR THROUGHOUT IS ASBESTOS CONTAINING.
 2. GREY WINDOW FRAME CAULKING APPLIED BETWEEN FRAME AND WALL ON EXTERIOR THROUGHOUT IS ASBESTOS-CONTAINING.
 3. 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

PENTICTON REGIONAL AIRPORT - 3000 AIRPORT ROAD, PENTICTON, BC

Client: PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC) ON BEHALF OF TRANSPORT CANADA (TC)

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Scale: N.T.S.
Date: 21/05/28
Dwn. By: CD <small>SL2021050272</small> CS/DM
App'd By: TW

Dwg. No.:

2



APPENDIX C
Summary of Results:
Analysis of Bulk Samples for Asbestos

PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix C Summary of Results: Analysis of Bulk Samples for Asbestos
June 15, 2021

Appendix C SUMMARY OF RESULTS: ANALYSIS OF BULK SAMPLES FOR ASBESTOS

**Table C.1 Suspected ACM Bulk Sample and Analytical Results Summary
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**

Material/ Homogenous Application Description	Sample Number	Sample Location	Result (% Asbestos)
Full-thickness roofing to plywood sheathing (supplemental samples): <ul style="list-style-type: none"> • RS-01A—asphalt cap membrane (top layer) • RS-01B—base membrane (2nd layer) • RS-01C—tar (3rd layer) • RS-01D—fiber board (4th layer) • RS-01E—styrofoam (5th layer) • RS-01F—felt and tar (6th layer) • RS-01G—roof paper (bottom layer above plywood sheathing) 	RS-01A	Roof, front, south side	None Detected
	RS-01B	Roof, front, south side	None Detected
	RS-01C	Roof, front, south side	None Detected
	RS-01D	Roof, front, south side	None Detected
	RS-01E	Roof, front, south side	None Detected
	RS-01F	Roof, front, south side	None Detected
	RS-01G	Roof, front, south side	None Detected
Full-thickness roofing to plywood sheathing (supplemental samples): <ul style="list-style-type: none"> • RS-02A—asphalt cap membrane (top layer) • RS-02B—base membrane (2nd layer) • RS-02C—tar (3rd layer) • RS-02D—fiber board (4th layer) • RS-02E—styrofoam (5th layer) • RS-02F—felt and tar (6th layer) • RS-02G—roof paper (bottom layer above plywood sheathing) 	RS-02A	Roof, rear, south side	None Detected
	RS-02B	Roof, rear, south side	None Detected
	RS-02C	Roof, rear, south side	None Detected
	RS-02D	Roof, rear, south side	None Detected
	RS-02E	Roof, rear, south side	None Detected
	RS-02F	Roof, rear, south side	None Detected
	RS-02G	Roof, rear, south side	None Detected
Full-thickness roofing to plywood sheathing (supplemental samples): <ul style="list-style-type: none"> • RS-03A—asphalt top membrane (top layer) • RS-03B—base membrane (2nd layer) • RS-03C—tar (3rd layer) • RS-03D—fiber board (4th layer) • RS-03E—styrofoam (5th layer) • RS-03F—felt and tar (6th layer) • RS-03G—roof paper (bottom layer above plywood sheathing) 	RS-03A	Upper roof, south side	None Detected
	RS-03B	Upper roof, south side	None Detected
	RS-03C	Upper roof, south side	None Detected
	RS-03D	Upper roof, south side	None Detected
	RS-03E	Upper roof, south side	None Detected
	RS-03F	Upper roof, south side	None Detected
	RS-03G	Upper roof, south side	None Detected
Asphalt roof patch, black with light grey specks (supplemental sample)	RP-01A	Upper roof, base of AHU-6	None Detected



PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix C Summary of Results: Analysis of Bulk Samples for Asbestos
June 15, 2021

**Table C.1 Suspected ACM Bulk Sample and Analytical Results Summary
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**

Material/ Homogenous Application Description	Sample Number	Sample Location	Result (% Asbestos)
Asphalt roofing, black—applied beneath light stand (supplemental samples)	RM-01A	Upper roof, rear	None Detected
	RM-01B	Upper roof, rear	None Detected
Asphalt roofing mastic—black—applied beneath asphalt roofing of light stand (supplemental samples)	RM-02A	Upper roof, rear	None Detected
	RM-02B	Upper roof, rear	None Detected
Roof flashing mastic—dark brown—applied between flashing seams (supplemental samples)	FM-01A	Roof, central, front	None Detected
	FM-01B	Roof, central, front	None Detected
Roof flashing—grey/clear—applied between skylight flashing and roof flashing (supplemental samples)	FM-02A	Roof, north skylight	None Detected
	FM-02B	Roof, north skylight	None Detected
Texture coat/stucco (patch)—applied to upper roof wall (supplemental samples)	TC-01A	South wall of upper roof	None Detected
	TC-01B	South wall of upper roof	None Detected
Pipe sealant—grey (painted yellow)—applied to threads of natural gas lines	PS-01A	Roof, central, front	None Detected
	PS-01B	Roof, central, front	None Detected
	PS-01C	Roof, central, front	None Detected
Window pane caulking, brown—applied between frame and pane	WPC-01A	Exterior, airside, south	None Detected
	WPC-01B	Exterior, airside, south	None Detected
	WPC-01C	Exterior, airside, south	None Detected
Foundation mastic, black—applied to base of foundation (supplemental samples)	FOM-01A	Exterior, front	None Detected
	FOM-01B	Exterior, front	None Detected
Window frame caulking, grey applied between frame and wall	WFC-01A	Exterior, front	0.48% Chrysotile
	WFC-01B	Exterior, front	0.46% Chrysotile
	WFC-01C	Exterior, front	0.56% Chrysotile
NOTES:			
1. Bold, highlighted text indicates confirmed ACM.			
2. Discrepancies between sampled material or location descriptions between this table and the laboratory certificate—this table is to be considered correct.			



APPENDIX D
Laboratory Analytical Report—
Asbestos: Polarized Light Microscopy



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EMSL Canada Order 692101098
 Customer ID: 55JACQ30L
 Customer PO:
 Project ID:

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Phone: (604) 412-3004
Fax:
Collected: 5/17/2021
Received: 5/18/2021
Analyzed: 5/26/2021

Proj: PSPC PENTICTON AIRPORT/123221854

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: RS-01A **Lab Sample ID:** 692101098-0001

Sample Description: ROOF,FRONT,SOUTH SIDE/ASPHALT CAP MEMBRANE (TOP LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-01B **Lab Sample ID:** 692101098-0002

Sample Description: ROOF,FRONT,SOUTH SIDE/BASE MEMBRANE (2ND LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-01C **Lab Sample ID:** 692101098-0003

Sample Description: ROOF,FRONT,SOUTH SIDE/TAR (3RD LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-01D **Lab Sample ID:** 692101098-0004

Sample Description: ROOF,FRONT,SOUTH SIDE/FIBER BOARD (4TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	Black	45.0%	55.0%	None Detected	

Client Sample ID: RS-01E **Lab Sample ID:** 692101098-0005

Sample Description: ROOF,FRONT,SOUTH SIDE/STYROFOAM (5TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	White	0.0%	100.0%	None Detected	

Client Sample ID: RS-01F **Lab Sample ID:** 692101098-0006

Sample Description: ROOF,FRONT,SOUTH SIDE/FELT AND TAR (6TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-01G **Lab Sample ID:** 692101098-0007

Sample Description: ROOF,FRONT,SOUTH SIDE/ROOF PAPER (BOTTOM LAYER ABOVE PLYWOOD SHEATHING)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Brown	0.0%	100%	None Detected	



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EMSL Canada Order 692101098
Customer ID: 55JACQ30L
Customer PO:
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: RS-02A **Lab Sample ID:** 692101098-0008
Sample Description: ROOF, REAR, SOUTH SIDE/ASPHALT CAP MEMBRANE (TOP LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-02B **Lab Sample ID:** 692101098-0009
Sample Description: ROOF, REAR, SOUTH SIDE/BASE MEMBRANE (2ND LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-02C **Lab Sample ID:** 692101098-0010
Sample Description: ROOF, REAR, SOUTH SIDE/TAR (3RD LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Brown/Black	0.0%	100%	None Detected	

Client Sample ID: RS-02D **Lab Sample ID:** 692101098-0011
Sample Description: ROOF, REAR, SOUTH SIDE/FIBER BOARD (4TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	Black	65.0%	35.0%	None Detected	

Client Sample ID: RS-02E **Lab Sample ID:** 692101098-0012
Sample Description: ROOF, REAR, SOUTH SIDE/STYROFOAM (5TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	White	0.0%	100.0%	None Detected	

Client Sample ID: RS-02F **Lab Sample ID:** 692101098-0013
Sample Description: ROOF, REAR, SOUTH SIDE/FELT AND TAR (6TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-02G **Lab Sample ID:** 692101098-0014
Sample Description: ROOF, REAR, SOUTH SIDE/ROOF PAPER (BOTTOM LAYER ABOVE PLYWOOD SHEATHING)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-03A **Lab Sample ID:** 692101098-0015
Sample Description: UPPER ROOF, SOUTH SIDE/ASPHALT TOP MEMBRANE (TOP LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	



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EMSL Canada Order 692101098
Customer ID: 55JACQ30L
Customer PO:
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: RS-03B **Lab Sample ID:** 692101098-0016
Sample Description: UPPER ROOF, SOUTH SIDE/BASE MEMBRANE (2ND LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-03C **Lab Sample ID:** 692101098-0017
Sample Description: UPPER ROOF, SOUTH SIDE/TAR(3RD LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-03D **Lab Sample ID:** 692101098-0018
Sample Description: UPPER ROOF, SOUTH SIDE/FIBER BOARD (4TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	Black	0.0%	100.0%	None Detected	

Client Sample ID: RS-03E **Lab Sample ID:** 692101098-0019
Sample Description: UPPER ROOF, SOUTH SIDE/STYROFOAM (5TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	White	0.0%	100.0%	None Detected	

Client Sample ID: RS-03F **Lab Sample ID:** 692101098-0020
Sample Description: UPPER ROOF, SOUTH SIDE/FELT AND TAR (6TH LAYER)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RS-03G **Lab Sample ID:** 692101098-0021
Sample Description: UPPER ROOF, SOUTH SIDE/ROOF PAPER (BOTTOM LAYER ABOVE PLYWOOD SHEATHING)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black/Beige	0.0%	100%	None Detected	

Client Sample ID: RP-01A **Lab Sample ID:** 692101098-0022
Sample Description: UPPER ROOF, BASE OF AHU-6/ASPHALT ROOF PATCH, BLACK WITH LIGHT GREY SPECKS (SUPPLEMENTAL SAMPLE)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: RM-01A **Lab Sample ID:** 692101098-0023
Sample Description: UPPER ROOF, REAR/ASPHALT ROOFING, BLACK- APPLIED BENEATH ASPHALT ROOFING OF LIGHT STAND (SUPPLEMENTAL SAMPLES)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	



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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:	RM-01B	Lab Sample ID:	692101098-0024
Sample Description:	UPPER ROOF, REAR/ASPHALT ROOFING, BLACK- APPLIED BENEATH ASPHALT ROOFING OF LIGHT STAND (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Black/Blue	0.0% 100% None Detected

Client Sample ID:	RM-02A	Lab Sample ID:	692101098-0025
Sample Description:	UPPER ROOF REAR/ASPHALT ROOFING MASTIC-BLACK-APPLIED BENEATH ASPHALT ROOFING OF LIGHT STAND (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Black	0.0% 100% None Detected

Client Sample ID:	RM-02B	Lab Sample ID:	692101098-0026
Sample Description:	UPPER ROOF REAR/ASPHALT ROOFING MASTIC-BLACK-APPLIED BENEATH ASPHALT ROOFING OF LIGHT STAND (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Black/Blue	0.0% 100% None Detected

Client Sample ID:	FM-01A	Lab Sample ID:	692101098-0027
Sample Description:	ROOF, CENTRAL, FRONT/ROOF FLASHING MASTIC - DARK BROWN - APPLIED BETWEEN FLASHING SEAMS (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Brown	0.0% 100% None Detected

Client Sample ID:	FM-01B	Lab Sample ID:	692101098-0028
Sample Description:	ROOF CENTRAL, FRONT/ROOF FLASHING MASTIC-DARK BROWN - APPLIED BETWEEN FLASHING SEAMS (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Brown	0.0% 100% None Detected

Client Sample ID:	FM-02A	Lab Sample ID:	692101098-0029
Sample Description:	ROOF, NORTH SKYLIGHT/ROOF FLASHING-GREY/CLEAR-APPLIED BETWEEN SKYLIGHT FLASHING AND ROOF FLASHING (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Gray/Clear	0.0% 100% None Detected

Client Sample ID:	FM-02B	Lab Sample ID:	692101098-0030
Sample Description:	ROOF, NORTH, SKYLIGHT/ROOF FLASHING-GREY/CLEAR-APPLIED BETWEEN SKYLIGHT FLASHING AND ROOF FLASHING (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM Grav. Reduction	5/26/2021	Gray/Clear	0.0% 100% None Detected

Client Sample ID:	TC-01A	Lab Sample ID:	692101098-0031
Sample Description:	SOUTH WALL OF UPPER ROOF/TEXTURE COAT/STUCCO (PATCH)-APPLIED TO UPPER ROOF WALL (SUPPLEMENTAL SAMPLES)		
TEST	Analyzed Date	Color	Non-Asbestos Fibrous Non-Fibrous Asbestos
PLM	5/26/2021	White	0.0% 100.0% None Detected



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 Customer ID: 55JACQ30L
 Customer PO:
 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: TC-01B **Lab Sample ID:** 692101098-0032

Sample Description: SOUTH WALL OF UPPER ROOF/TEXTURE COAT/STUCCO(PATCH)-APPLIED TO UPPER ROOF WALL (SUPPLEMENTAL SAMPLES)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	5/26/2021	White	0.0%	100.0%	None Detected	

Client Sample ID: PS-01A **Lab Sample ID:** 692101098-0033

Sample Description: ROOF, CENTRAL, FRONT/PIPE SEALANT-GREY(PAINTED YELLOW)-APPLIED TO THREADS OF NATURAL GAS LINES

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Yellow	0.0%	100%	None Detected	

Client Sample ID: PS-01B **Lab Sample ID:** 692101098-0034

Sample Description: ROOF, CENTRAL, FRONT/PIPE SEALANT-GREY(PAINTED YELLOW)-APPLIED TO THREADS OF NATURAL GAS LINES

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Yellow	0.0%	100%	None Detected	

Client Sample ID: PS-01C **Lab Sample ID:** 692101098-0035

Sample Description: ROOF, CENTRAL, FRONT/PIPE SEALANT-GREY(PAINTED YELLOW)-APPLIED TO THREADS OF NATURAL GAS LINES

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Yellow	0.0%	100%	None Detected	

Client Sample ID: WPC-01A **Lab Sample ID:** 692101098-0036

Sample Description: EXTERIOR, AIRSIDE, SOUTH/WINDOW OANE CAULKING,BROWN-APPLIED BETWEEN FRAME AND PANE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Brown	0.0%	100%	None Detected	

Client Sample ID: WPC-01B **Lab Sample ID:** 692101098-0037

Sample Description: EXTERIOR, AIRSIDE, SOUTH/WINDOW OANE CAULKING,BROWN-APPLIED BETWEEN FRAME AND PANE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Gray	0.0%	100%	None Detected	

Client Sample ID: WPC-01C **Lab Sample ID:** 692101098-0038

Sample Description: EXTERIOR. AIRSIDE, SOUTH/WINDOW OANE CAULKING,BROWN-APPLIED BETWEEN FRAME AND PANE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Brown	0.0%	100%	None Detected	

Client Sample ID: FOM-01A **Lab Sample ID:** 692101098-0039

Sample Description: EXTERIOR, FRONT/FOUNDATION MASTIC,BLACK-APPLIED TO BASE OF FOUNDATION (SUPPLEMENTAL SAMPLES)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	



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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: FOM-01B **Lab Sample ID:** 692101098-0040

Sample Description: EXTERIOR, FRONT/FOUNDATION MASTIC,BLACK-APPLIED TO BASE OF FOUNDATION (SUPPLEMENTAL SAMPLES)

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Black	0.0%	100%	None Detected	

Client Sample ID: WFC-01A **Lab Sample ID:** 692101098-0041

Sample Description: EXTERIOR, FRONT/WINDOW FRAME CAULKING, GREY APPLIED BETWEEN FRAME AND WALL

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Brown/Beige	0.0%	99.5%	0.48% Chrysotile	

Client Sample ID: WFC-01B **Lab Sample ID:** 692101098-0042

Sample Description: EXTERIOR, FRONT/WINDOW FRAME CAULKING, GREY APPLIED BETWEEN FRAME AND WALL

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Gray	0.0%	99.5%	0.46% Chrysotile	

Client Sample ID: WFC-01C **Lab Sample ID:** 692101098-0043

Sample Description: EXTERIOR, FRONT/WINDOW FRAME CAULKING, GREY APPLIED BETWEEN FRAME AND WALL

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	5/26/2021	Gray/White	0.0%	99.4%	0.56% Chrysotile	

Analyst(s):

Chloe Huang PLM (8)
PLM Grav. Reduction (16)
Nicole Yeo PLM Grav. Reduction (19)

Reviewed and approved by:

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. 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. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government.

Samples analyzed by EMSL Canada Inc. Burnaby, BC NVLAP Lab Code 201068-0

Initial report from: 05/26/2021 16:16:13




APPENDIX E
**Summary of Identified Asbestos-
Containing Materials**

PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix E Summary of Identified Asbestos-Containing Materials
June 15, 2021

Appendix E SUMMARY OF IDENTIFIED ASBESTOS-CONTAINING MATERIALS

**Table E.1 Summary of Identified Asbestos-Containing Materials that will be Impacted by the Project
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road, Penticton BC**

Identified ACM Description and Condition Information	
Texture coat/stucco applied to exterior walls and soffit	
% Type	4.1%–5.0% Chrysotile (2016 SNC Report)
Friability	Non-friable in situ; potentially friable during removal
Condition	Overall good, minor peeling in some locations
 <p>Front of Building, Near Entrance</p>	
 <p>Rear of Building, Airside, Near Customs Office</p>	
Grey window putty applied between pane and frame on interior	
% Type	1.2%–10% Chrysotile (2016 SNC Report)
Friability	Non-friable
Condition	Good
	



PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix E Summary of Identified Asbestos-Containing Materials
 June 15, 2021

**Table E.1 Summary of Identified Asbestos-Containing Materials that will be Impacted by the Project
 Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
 Penticton BC**

Identified ACM Description and Condition Information	
Grey window frame caulking applied between frame and wall on exterior.	
% Type	0.46%–0.56% Chrysotile
Friability	Non-friable
Condition	Good



APPENDIX F
Summary of Results:
Analysis of Paint Chip Samples for Lead

PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix F Summary of Results: Analysis of Paint Chip Samples for Lead
June 15, 2021

Appendix F SUMMARY OF RESULTS: ANALYSIS OF PAINT CHIP SAMPLES FOR LEAD

**Table F.1 Suspected Lead-Containing Paint Sample and Analytical Results Summary
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**

Sample Number	Paint Colour/Application	Sample Location	Result (ppm)
P-01	Brown on metal flashing and corrugated metal walls	Roof, central	<80
P-02	Grey on steel natural gas lines	Upper roof, central	<80
P-03	Grey on metal "Trane" air handling unit	Upper roof, central	<80
P-04	Beige on metal "Lennox" air handling unit	Roof, central	1,000
P-05	Green on metal vent casing	Roof, south	1,700
P-06	Brown texture coat/stucco wall	Exterior, front	<80
P-07	Blue on texture coat/stucco column	Exterior, front	<80
P-08	Brown on wood panel walls (newer vintage)	Exterior, front	<80
P-09	Blue on wood columns	Exterior, front	<80
P-10	White on texture coat/stucco wall	Exterior, rear	<80
P-11	Grey on lower wood trim and walls	Exterior, rear	3,700
P-12	Light brown on wood panel walls and trim	Roof, upper roof wall	300

NOTES:

1. Bold, highlighted text indicates confirmed LCP.
2. Discrepancies between sampled material or location descriptions between this table and the laboratory certificate—this table is to be considered correct.



APPENDIX G
Laboratory Analytical Report—
Lead: Paint Chip Analysis

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EMSL Canada Or	652104289
CustomerID:	55JACQ30L
CustomerPO:	123221854
ProjectID:	

Attn: **Steve Chou**
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
 Fax:
 Received: 5/20/2021 08:30 AM
 Collected:

Project: **PSPC PENTICTION AIRPORT / 123221854****Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)***

<i>Client Sample Description</i>	<i>Lab ID</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Weight</i>	<i>Lead Concentration</i>
P-01 Site: RROF, CENTRAL Desc: BROWN ON METAL FLASHING AND CORRUGATED METAL WALLS	652104289-0001		5/26/2021	0.2667 g	<80 ppm
P-02 Site: UPPER ROOF, CENTRAL Desc: GREY ON STEEL NATURAL GAS LINES	652104289-0002		5/26/2021	0.2512 g	<80 ppm
P-03 Site: UPPER ROOF, CENTRAL Desc: GREY ON METAL "TRANE" AIR HANDLING UNIT	652104289-0003		5/26/2021	0.2557 g	<80 ppm
P-04 Site: ROOF, CENTRAL Desc: BEIGE ON METAL "LENNOX" AIR HANDLING UNIT	652104289-0004		5/26/2021	0.2623 g	1000 ppm
P-05 Site: ROOF, SOUTH Desc: GREEN ON METAL VENT CASING	652104289-0005		5/26/2021	0.1474 g	1700 ppm
P-06 Site: EXTERIOR, FRONT Desc: BROWN TEXTURE COAT/STUCCO WALL	652104289-0006		5/26/2021	0.2525 g	<80 ppm
P-07 Site: EXTERIOR, FRONT Desc: BLUE ON TEXTURE COAT/STUCCO COLUMN	652104289-0007		5/26/2021	0.2615 g	<80 ppm
P-08 Site: EXTERIOR, FRONT Desc: BROWN ON WOOD PANEL WALL (NEWER VINTAGE)	652104289-0008		5/26/2021	0.2581 g	<80 ppm
P-09 Site: EXTERIOR, FRONT Desc: BLUE ON WOOD COLUMNS	652104289-0009		5/26/2021	0.2555 g	<80 ppm
P-10 Site: EXTERIOR, REAR Desc: WHITE ON TEXTURE COAT/STUCCO WALL	652104289-0010		5/26/2021	0.2575 g	<80 ppm

Jefferson Salvador, Laboratory Manager
 or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. 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. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted.

Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Calgary, AB CALA Accreditation #A3942

Initial report from 05/26/2021 14:55:14



EMSL Canada Inc.

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EMSL Canada Or 652104289
CustomerID: 55JACQ30L
CustomerPO: 123221854
ProjectID:

Attn: **Steve Chou**
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Received: 5/20/2021 08:30 AM
Collected:

Project: **PSPC PENTICTION AIRPORT / 123221854**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

<i>Client Sample Description</i>	<i>Lab ID</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Weight</i>	<i>Lead Concentration</i>
P-11	652104289-0011	5/26/2021		0.2661 g	3700 ppm
Site: EXTERIOR, REAR Desc: GREY ON LOWER WOOD TRIM					
P-12	652104289-0012	5/26/2021		0.2662 g	300 ppm
Site: ROOF, UPPER ROOF WALL Desc: LIGHT BROWN ON WOOD PANEL WALLS AND TRIM					

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or other approved signatory

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Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
Samples analyzed by EMSL Canada Inc. Calgary, AB CALA Accreditation #A3942

Initial report from 05/26/2021 14:55:14



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Phone: (604) 412-3004
Fax:
Received: 5/20/2021 08:30 AM
Collected:

Project: **PSPC PENTICTION AIRPORT / 123221854**

Test Report: Toxicity Characteristic Leachate Procedure (1311/7000B)

<i>Client Sample Description</i>	<i>Lab ID</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Lead Concentration</i>
L-02	652104429-0001	5/27/2021		23 mg/L
Site: ROOF, UPPER ROOF SOFFIT Desc: WHITE ON WOOD SOFFIT Sample is <100 grams; analyzed at client's request.				
L-03	652104429-0002	5/27/2021		0.91 mg/L
Site: EXTERIOR, REAR Desc: DARK BROWN ON WOOD TRIM Sample is <100 grams; analyzed at client's request.				
L-04	652104429-0003	5/27/2021		0.86 mg/L
Site: EXTERIOR, REAR Desc: GREY ON LOWER WOOD TRIM Sample is <100 grams; analyzed at client's request.				

Jefferson Salvador, Laboratory Manager
or other approved signatory

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Samples analyzed by EMSL Canada Inc. Calgary, AB

Initial report from 05/27/2021 14:55:13

APPENDIX H


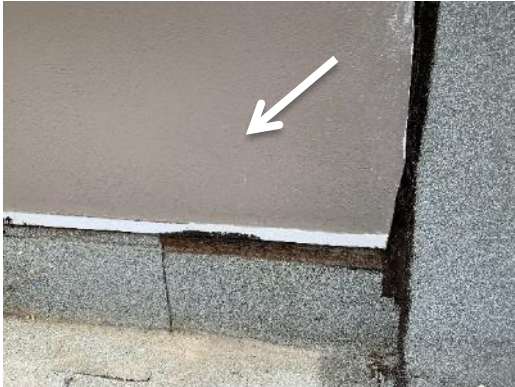
Summary of Identified LCPs

PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix H Summary of Identified LCPs
June 15, 2021

Appendix H SUMMARY OF IDENTIFIED LCPS

**Table H.1 Summary of Identified LCPs that will be Impacted by the Project
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**



LCP Description		Photo
Paint colour	Brown (blue under)	
Substrate	Metal	
Location/approx. extent	Doors and window frames	
Lead content	8,350 ppm (2016 SNC Report)	
Condition	Good	
Paint colour	Grey	
Substrate	Texture coat/stucco	
Location/approx. extent	Exterior wall patch on the raised portion of the roof	
Lead content	732 ppm (2016 SNC Report)	
Condition	Good	



PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix H Summary of Identified LCPs
June 15, 2021

**Table H.1 Summary of Identified LCPs that will be Impacted by the Project
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**


LCP Description		Photo
Paint colour	White	
Substrate	Wood	
Location/approx. extent	Exterior soffit on the raised portion of the roof	
Lead content	34,500 ppm (2016 SNC Report)	
Condition	Good	
Paint colour	Dark Brown	
Substrate	Wood	
Location/approx. extent	Exterior trim	
Lead content	3,430 ppm–4,080 ppm (2016 SNC Report)	
Condition	Overall good, minor flaking and peeling in some locations	
Paint colour	Light brown (blue under). Painted dark brown on exterior of doors.	
Substrate	Metal	
Location/approx. extent	Doors	
Lead content	5,700 ppm (2016 SNC Report)	
Condition	Good	



PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix H Summary of Identified LCPs
June 15, 2021

**Table H.1 Summary of Identified LCPs that will be Impacted by the Project
Air Terminal Building at the Penticton Regional Airport, 3000 Airport Road,
Penticton BC**

LCP Description		Photo
Paint colour	Grey	
Substrate	Wood	
Location/approx. extent	Exterior lower walls and trims of Customs Office (117), Airport ECCO (118), Airport Conference Room (120) and NAVCAN Office (123) on airside of the building.	
Lead content	3,700 ppm	
Condition	Good	



Penticton Regional Airport
Penticton ATB Roofing & Building Envelope Project
Project: R.105676.001

APPENDIX B2

Hazardous Building Materials Assessment



SNC • LAVALIN

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Penticton Airport Terminal Building, 3000 Airport Road, Penticton, BC

March 31, 2016
Project 636476

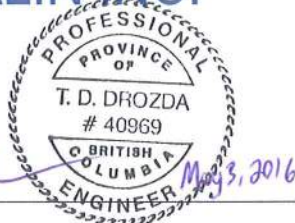
Prepared for:

Public Works and Government Services Canada

SNC-LAVALIN INC.

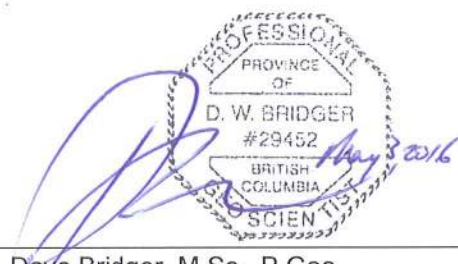
Prepared By:

Tim Drozda, P.Eng.
Environmental Scientist



Reviewed By:

Tony Kavelaars, A.Sc.T., EP(CEA)
Senior Technical Specialist



Dave Bridger, M.Sc., P.Geo.
Project Manager

EXECUTIVE SUMMARY

On behalf of Public Works and Government Services Canada (PWGSC), SNC-Lavalin Inc. (SNC-Lavalin) has completed a pre-renovation non-destructive hazardous building materials survey (HBMS) of the airport terminal building located at 3000 Airport Road, Penticton, BC. PWGSC requested the HBMS in preparation for renovations which are planned in the near future.

Between March 28 and 30, 2016, SNC-Lavalin completed a room-by-room survey of the accessible areas of the airport terminal building to quantify suspected designated substances and hazardous materials, and collect representative samples for laboratory analysis of select materials for asbestos and lead content.

The survey and sampling program identified asbestos in the following building materials: drywall joint compound, vinyl floor tiles, concrete pipes, bell and spigot cast iron pipe joint packing, gaskets, pipe thread sealant, window putty, HVAC ducting mastic, tar and exterior ceiling and wall texture coat.

Potential asbestos-containing materials may be present in the following building materials: vermiculite insulation, fire doors, electrical wiring, gaskets and underground piping.

Analytical results confirmed the presence of lead-based paints in 31 of the 49 paint samples collected throughout the interior and exterior of the building. As per PWGSC direction, no leachate analyses were carried out.

The survey and sampling program also identified the following other designated substances or hazardous materials of potential concern:

- Potentially polychlorinated biphenyls (PCB)-containing fluorescent and high intensity discharge (HID) light ballasts throughout the interior and exterior of the building.
- Ozone depleting substances (ODS)-containing air conditioning units, water cooling units, refrigerator/freezer units and other refrigeration equipment.
- Confirmed/potential lead-containing materials (lead-acid batteries, lead solder, lead roof vent pipes, and lead packing in bell and spigot piping).
- Fire extinguishers (compressed gas) mounted on the interior walls and stored in rooms throughout the building.
- Miscellaneous potentially hazardous consumer products including paint, oil, propane and various chemicals and cleaning products.
- Liquid mercury in thermostats located in select rooms of the building.

- Silica potentially in concrete, ceramic tiles, ceiling tiles, mortar, and drywall, where present in the building.

While effort was made to identify all hazardous building materials, a number are suspected to be hidden/inaccessible in the building. Surveys in conjunction with renovation activities are recommended to identify such materials.

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In-Text Tables

1: Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC19

Appendices

- I Drawings:
 - 636476-BM1 – Sample Location Plan – First Floor
 - 636476-BM2 – Sample Location Plan – Roof
- II Photographs
- III Laboratory Analytical Report (IATL)
- IV Laboratory Analytical Report (Maxxam)

PICPIPWGSC\636476-PENTICTON AIRPORT\5.0\5.3\R331TDA_PENTICTON AIRPORT HBMS.DOCX

1 INTRODUCTION

On behalf of Public Works and Government Services Canada (PWGSC), SNC-Lavalin Inc. (SNC-Lavalin) has completed a pre-renovation non-destructive hazardous building materials survey (HBMS) of the airport terminal building located at 3000 Airport Road, Penticton, BC (the “Site”). SNC-Lavalin understands that the purpose of the work was to complete a non-destructive HBMS of the building (with exception to the Hold Room and Air Control Building) to identify potential materials of concern. At the time of the survey, the terminal was active; however, the areas of the building were unoccupied during the assessment.

All work was completed as per the *Hazardous Materials Assessment Consulting Services Task Authorization – EZ113-150642/003/PWY* under Task Authorization No. 70034882 (Amend 1).

2 SCOPE OF WORK

Between March 28 and 30, 2016, SNC-Lavalin personnel observed the interior and exterior of the Site to identify the potential existence of the following regulated materials:

- asbestos;
- lead paint;
- polychlorinated biphenyls (PCB);
- ozone depleting substances (ODS);
- miscellaneous solid and liquid wastes;
- liquid mercury;
- radiological sources and/or substances;
- silica; and
- mould and/or moisture.

The scope of work for the HBMS excluded the following materials: formaldehyde; carbon monoxide; radon; volatile organic compounds; biological hazards (e.g., rodent droppings); very short-lived low-level radioactive waste; and, indoor air quality pollutants.

Representative samples were collected and laboratory analysis completed for suspected asbestos-containing materials (ACMs) and lead-containing paint. The survey was completed based on the expectation that portions of the building would be renovated in the future. As such, non-destructive sampling methods were utilized to inspect and where appropriate, collect samples of materials of interest. Effort was made to identify materials of potential concern within hidden or concealed spaces; however, due to the non-destructive nature of the survey, inspection and sampling was limited to the extent that was possible without causing obvious and/or irreparable damage to building materials in active areas of the building that could not be feasibly repaired within the scope of this work program. For samples that were collected, effort was made to obtain the samples from discrete locations or locations where the building materials were already in poor condition.

The following sections provide a summary of the results, SNC-Lavalin's recommendations with regard to the Site, details of the regulatory framework related to regulated building materials, and the methodology used to complete the survey. Limitations and/or exclusions are also discussed in the following sections as they relate to the work program results.

3 SUMMARY

Based on the results of the survey, there are regulated building materials located on the Site requiring specific procedures prior to renovation activities for: handling; abatement; demolition; and disposal, as outlined in Table 1. The sample locations are presented on Drawings 636476-BM1 and 636476-BM2, included as Appendix I. Select photographs of the sample locations are included in Appendix II. Copies of the laboratory analytical reports for the results of the asbestos and lead analyses are included in Appendices III and IV, respectively.

A summary of the regulated building materials identified on the Site is as follows:

Asbestos-Containing Materials:

- **Asbestos-containing drywall joint compound** was identified in Rooms 106A, 120, 124, 125, and 130. Due to the variability in drywall joint compound results, all drywall joint compound in the building should be treated as ACM.
- **Asbestos-containing light grey vinyl floor tiles** were identified in Rooms 106B (within the small wall compartment on the west wall, north of the building entrance), 109, 112, 114, 125, and 129. Similar coloured asbestos-containing vinyl floor tile debris was identified in the northeast flooring vent in Room 120. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing green vinyl floor tiles (and associated black mastic adhesive)** were identified in Rooms 127, 128A, 128B, 132, 133, 134, 135, 136. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing grey vinyl floor tiles (and associated black mastic adhesive)** were identified in Rooms 123 and 124. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing light brown vinyl floor tiles** were identified in Room 129 beneath the lockers on the north and south walls. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing tan vinyl floor tiles** were identified in Rooms 115, 116A, 117, and 119. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing grey concrete pipe** was identified in the crawlspace of Room 127. The same pipe was observed sticking out of the ground (vertical) and capped on the exterior of the west side of the building adjacent Room 133. Similar piping may be present in other areas of the crawlspace, walls spaces and/or ceiling spaces, or buried beneath the ground.

- **Asbestos-containing bell and spigot cast iron pipe joint packing** was identified in one joint attached to the asbestos-containing concrete pipe in the crawlspace of Room 127. Similar inaccessible piping joints may be present in other areas of the crawlspace, walls spaces and/or ceiling spaces.
- **Asbestos-containing gaskets** were identified in the crawlspace of Room 127 and in the mechanical room (Room 137), both of which were grey gaskets. All similar gaskets should be treated as ACM. Due to the limited access to working pipe joints, limited sampling could be completed.
- **Asbestos-containing pipe thread sealant** was identified in Rooms 124 and 143 on the fire sprinkler lines. All fire sprinkler line pipe thread sealant should be considered ACM.
- **Asbestos-containing white floor leveling compound** was identified beneath the vinyl floor tiles in Room 123. The extent of the floor leveling compound could not be determined based on the non-destructive nature of the survey. If any similar compound is identified in the building, it should be treated as ACM.
- **Asbestos-containing grey window putty** was identified in Rooms 120 (northeast corner) and 117 (east side of room), of which the windows are adjoining. All similar window putty should be considered ACM.
- **Asbestos-containing grey window putty** was identified on the upper windows in Room 106A above Room 143. All similar putty on the upper windows in the building should be treated as ACM.
- **Asbestos-containing red mastic** was identified on HVAC ducting in the crawlspace of Room 136. There may be similar mastic that was inaccessible during the survey in other areas of the crawlspace and ceiling spaces; if similar mastic is identified, it should be treated as ACM.
- **Asbestos-containing tar** was identified by the base of the doorframe of the southeast door of Room 110. All similar tar should be considered ACM.
- **Asbestos-containing exterior ceiling and wall texture** was identified on the south and west exterior walls and ceiling (carport area on the south end of the building). All similar exterior texture coat should be considered ACM.

Suspect Asbestos-Containing Materials:

- Vermiculite contaminated with asbestos may also be present in wall cavities and ceiling spaces within the building. No vermiculite was encountered during the survey; however, the absence of vermiculite insulation could not be confirmed in all areas during the survey. If encountered during renovations, vermiculite insulation must be handled as ACMs unless testing confirms otherwise.

- Fire doors to the entrances of Rooms 137 and 138 may contain asbestos-containing filler material. No other fire doors were identified at the Site; however, if any similar fire doors are identified, they should be treated as ACM.
- Electrical wiring insulation throughout the building may contain ACMs; however, this material was not sampled due to safety concerns with live electrical wiring.
- ACMs within equipment; no dismantling of equipment was completed and therefore, inspection and sampling of gaskets in operating equipment/piping was limited. Similarly, only the exterior of electrical equipment in the building, including switch boxes, was visually inspected for potential asbestos containing insulating panels (i.e., no opening of electrical boxes and no sampling), due to possible related safety concerns.
- Asbestos-containing cement pipes could be present at the Site as one ACM pipe was observed in the crawlspace. The identification of potential ACMs below ground was not within the scope of this report, and should be addressed during any excavation at the Site.

Lead-Based Paint:

- **Lead-containing light brown and blue paint** was identified on the door of Rooms 125 and 130.
- **Lead-containing brown and blue paint** was identified on the door and window frames of Room 125.
- **Lead-containing white paint** was identified on the walls of Room 125.
- **Lead-containing green paint** was identified on the door frame of Rooms 127 and 135.
- **Lead-containing grey paint** was identified on the wall panels in Room 127.
- **Lead-containing beige paint** was identified on the wall trim in Room 120.
- **Lead-containing white and off-white paint** was identified on the walls of Room 106A (collected above Room 143). Similar paint colours were identified in Rooms 102, 105A, and 106B.
- **Lead-containing light blue and white paint** was identified on the door frame of Room 109.
- **Lead-containing exterior yellow paint** was identified on a steel pipe on the roof.
- **Lead-containing exterior grey paint** was identified on the wall of the raised portion of the roof.
- **Lead-containing exterior white paint** was identified on the soffit of the raised portion of the roof.
- **Lead-containing exterior black paint** was identified on the ladder to the raised portion of the roof located on the south west side.
- **Lead-containing exterior dark brown paint** was identified on the window trim on the east side of the raised portion of the roof.

- **Lead-containing exterior white, tan and light grey paint** was identified on the concrete foundation (above ground portion).
- **Lead-containing exterior blue paint** was identified on the exterior walls of the building.
- **Lead-containing exterior dark brown paint** was identified on the door frame to Room 125.
- **Lead-containing pink paint** was identified on the walls and ceiling of Room 128B.
- **Lead-containing grey floor paint** was identified in Room 138.
- **Lead-containing beige paint** was identified on the walls of Room 137 and 138.
- **Lead-containing grey primer paint** was identified on the wall in the ceiling space of Room 142.
- **Lead-containing light brown paint** was identified on the door frame of Room 132.
- **Lead-containing red paint** was identified on the window frames on the west wall of Room 106B.
- **Lead-containing brown paint** was identified on the door to the wall cabinet in Room 106B (north of the main entrance, Room 101).
- **Lead-containing yellow paint** was identified in the wall cabinet in Room 106B.
- **Lead-containing yellow paint** was identified on the door frame of Room 112.
- **Lead-containing beige paint** was identified on the walls and pipes in Room 110B.

Based on these results, all materials found at the Site of similar colours as identified above should be considered as lead-containing.

PCB Materials:

- **Potentially PCB-containing light ballasts (fluorescent and high intensity discharge [HID])** were identified throughout the interior and exterior of the building.

Ozone Depleting Substances (ODS):

R404a Refrigerant (Non-ODS)

- Room 162 – One (1) ice maker and one (1) freezer.

R134a Refrigerant (Non-ODS)

- Room 162 – One (1) refrigerator;
- Room 161 – One (1) cooler;

- Room 151B – One (1) water cooler;
- Room 110A – One (1) refrigerator;
- Room 113 – One (1) water cooler;
- Room 116A – One (1) refrigerator;
- Room 116B – One (1) freezer; and
- Room 140 – One (1) water cooler (black) and one (1) refrigerator.

R410a Refrigerant (Non-ODS)

- Room 136 – One (1) wall mounted air conditioning unit; and
- Room 162 – One (1) air conditioning unit.

R22 Refrigerant (ODS)

- Room 161 – One (1) upright cooler; and
- Room Roof – Six (6) air conditioner units (2, 4, 5, 6, 7, and 8).

Unknown Refrigerant (Suspect ODS [no ID tag accessible])

- Room 113 – One (1) refrigerator;
- Room 134 – One (1) refrigerator; and
- Room 140 – One (1) water cooler (white).

Miscellaneous Solid and Liquid Wastes:

- **Lead-based batteries** were identified in Room 127:
 - Two (2) batteries (one in each fire control box) on the west wall;
 - Eight (8) car sized batteries on the south wall; and
 - One (1) battery in the control box on the east wall.
- **Potential lead-based batteries** were identified in the following locations:
 - Room 125 – Fire control box;
 - Room 138 – Electrical equipment and/or control boxes that were inaccessible during the survey; and

- Rooms 102, 109, 106B, 112, and 127 – Emergency lighting boxes.
- **Potential lead-containing soldering equipment and supplies** was identified in Room 133.
- **Potential lead-containing copper pipe solder joints** were identified throughout the building. Copper pipe joints may be hidden in the crawlspace, wall and ceiling spaces and could not be identified due to the non-destructive nature of the survey.
- **Potential lead-containing bell and spigot cast iron pipe joint packing** was identified in the crawlspace of Room 127.
- **Potential lead-containing roof vent pipes** were identified on the exterior roof.
- **Approximately twelve (12) fire extinguishers** were identified in Rooms 105B, 107, 110, 114, 116A, 124, 127, 135, 136, 138 and 162.
- **Various cleaning supplies** were identified in Room 128A (janitor's storage room).
- **Flammable storage box** was identified containing small quantities of various paints, oils, propane, etc.
- **Nine (9) Sinclair canisters** were identified in Room 135. The canisters appeared empty and contents unknown (no additional labels).

Liquid Mercury:

- **Four (4) mercury-containing thermostats** were identified in Rooms 110 (two thermostats), 140 and 142.

Silica:

- Silica may be present throughout the building in the following materials:
 - Concrete floors;
 - Ceramic tiles;
 - Ceiling tiles;
 - Mortar; and
 - Drywall.

4 RECOMMENDATIONS

SNC-Lavalin understands that PWGSC intends to renovate and/or deconstruct various portions of the building that was surveyed.

When PWGSC undertakes demolition or deconstruction activities, then known and suspect ACMs that were identified must be removed by a qualified contractor in accordance with applicable federal and provincial regulations.

WorkSafeBC suggests that improper removal of paint with a lead concentration of 600 mg/kg or more can result in airborne lead concentrations that exceed 50% of the airborne lead exposure limit of 0.05 mg/m³; this would trigger the requirement for an employer to file a Notice of Project Lead (NOPL) and the development and implementation of an exposure control plan and safe work procedures prior to any work being completed.

There is the potential for lead exposure for high risk individuals in the event that lead-based paint with lead concentrations >90 mg/kg is burned and/or becomes airborne during renovation, deconstruction/demolition activities such as cutting, grinding, etc. Therefore, these individuals should be excluded from the work area whenever lead-based paint is being disturbed by work activities to minimize potential lead exposure to these individuals.

The waste generated from removal of paint and surface coatings may be hazardous. Given the possible need for off-site disposal of waste material during renovations, laboratory analysis for preliminary waste characterization of select samples (concentrations of metals in the leachate) may be required. Based on discussions with PWGSC, this sampling was specifically excluded from the assessment. If leachate analysis (Toxicity Characteristic Leaching Procedure [TCLP]) is required for disposal of materials containing hazardous lead concentrations, SNC-Lavalin will be available to collect and submit additional samples, as required.

Suspected silica-containing material, such as the buildings concrete floors, ceramic tiles, ceiling tiles, mortar and drywall, must be managed appropriately. Parts 5, 6 and 20 of the *Occupational Health and Safety Regulation* (OHSR) set out occupational exposure guidelines and controls for silica dust to eliminate, reduce, or manage workers' exposure risk. WorkSafeBC identifies the requirement to develop an exposure control plan to protect workers from overexposure to airborne silica dust in excess of 50% of the exposure limit (i.e., crystalline silica has an OHSR occupational exposure limit of 0.025 mg/m³).

If PWGSC undertakes renovations or deconstruction activities at the Site, PWGSC should require that the qualified contractors (i.e., abatement, demolition and/or disposal contractors) submit the following documentation to PWGSC to verify that the qualified contractors have acted in a responsible manner in accordance with the existing applicable regulations:

- Notice of project for work involving asbestos (NOPA) to be filed with WSBC prior to asbestos abatement;
- NOPL to be filed with WSBC prior to lead abatement;
- Site-specific work procedures for materials of concern (asbestos and lead procedures are included with NOPA and NOPL);
- Letter stating that the ODS recovery, liquid mercury and PCB disposal work, if required, was completed; and
- Relevant Waste Disposal Manifests.

The above documentation should be retained by PWGSC to verify compliance with the applicable regulations. The information supplied by the contractor(s) should include, but not be limited to the above list.

5 REGULATORY FRAMEWORK

Federal and provincial regulations require that regulated building materials be properly identified and managed to prevent potential exposure to workers. In addition, a more intrusive survey is required to identify materials of concern prior to renovations, salvage, or demolition of a building or structure. These materials must be properly controlled, removed, and/or disposed of at a suitably permitted facility in accordance with the applicable federal and provincial regulations. The following federal and provincial regulations relate to these materials:

Federal

- Various Regulations made under the *Canadian Environmental Protection Act (CEPA)*, 1999, S.C. 1999, c. 33, as amended up to February 26, 2015 and current to October 15, 2015, including specialized handling and/or disposal requirements for materials including lead, PCBs, mercury, halocarbons (ODSs and Non-ODSs), radiological sources and/or substances and solid/hazardous wastes. Regulations include the following:
 - Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
 - Federal Halocarbon Regulations, 2003 (SOR/2003-289) and Regulations Amending the Federal Halocarbon Regulations, 2003 (SOR/2009-221).
 - Interprovincial Movement of Hazardous Waste Regulations (SOR/2002-301).
 - Ozone-Depleting Substances Regulations, 1998 (SOR/99-7).
 - PCB Regulations (SOR/2008-273).
 - PCB Waste Export Regulations, 1996 (SOR/97-109).
 - Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations, 2008 (SOR/2008-197).
- *Transportation of Dangerous Goods (TDG) Act*, 1992, S.C. 1992, c. 34, as amended up to February 26, 2015, Transportation of Dangerous Goods Regulations (SOR/2001-286) requires that dangerous goods including radioactive materials must be transported in accordance with the provisions of the Act and regulations.
- *Hazardous Products Act* (R.S.C., 198, c. H-3), as amended up to February 11, 2015, prohibits the sale or importation of UFFI into Canada.
- *Surface Coating Materials Regulations*, SOR/2005-109, as amended up to June 20, 2011, issued under the Canada Consumer Product Safety Act (S.C. 2010, c. 21), requires the concentration of total lead present in a surface coating material to be not more than 90 mg/kg.

- *Human Resources Social Development Canada (HRSDC), Canada Labour Code Part II, Canada Occupational Health and Safety Regulations, Part X, Hazardous Substances*, as amended, requires that all hazardous substances in the workplace, including asbestos, be identified and controlled to minimize potential exposure to workers. Under the Canada Labour Code Part II definitions, a “hazardous substance” includes a controlled product and a chemical, biological, or physical agent that, by reason of a property that the agent possess, is hazardous to the safety or health of a person exposed to it.
- *Mould Guidelines for Canadian Construction Industry - CCA82, Canadian Construction Association, 2004*, provides guidance on minimizing and abating mould growth.
- *The Nuclear Safety and Control Act (1997, c.9), Nuclear Substances and Radiation Devices Regulations (SOR/2000-207)* applies to nuclear substances and sealed sources, including devices such as smoke detectors.

Provincial

- *WorkSafeBC Occupational Health and Safety Regulation (OHSR), BC Reg. 296/97*, includes amendments up to B.C. Reg. 30/2015, August 4, 2015, requires that materials including any asbestos, lead, or other heavy metal or toxic substance, and flammable or explosive materials that may be handled, disturbed or removed during demolition must be identified and removed or safely contained prior to demolition. In addition, a copy of the observation report identifying these materials must be available at the work site.
- *Environmental Management Act (EMA), B.C. Reg. 54/2016 / March 2, 2016, Ozone Depleting Substances (ODS) and Other Halocarbons Regulation, BC Reg. 387/99*, including amendments up to BC Reg. 317/2012, requires ODS to be recovered from equipment prior to disposal.
- *Hazardous Waste Regulation (HWR), B.C. Reg. 63/88*, including amendments up to B.C. Reg. 63/2009, requires all Hazardous Wastes (HW) must be properly managed and disposed of.

We note that at the time of this report, the provincial OHSR defines ACM as any manufactured article or other material which contains 0.5% or more asbestos by weight and vermiculite insulation containing any amount of asbestos. Other federal and provincial legislation defines ACM as containing 1% or more asbestos by weight. Therefore, for the purposes of this report the more stringent criterion of 0.5% has been used to identify ACM.

Federal and provincial guidelines limit lead concentrations in paint to 90 mg/kg for high risk individuals (i.e., pregnant women and children), and any concentrations that exceed this limit would be considered a lead based paint. WorkSafeBC suggests that improper removal of paint with a lead concentration of 600 mg/kg or more can result in airborne lead concentrations that exceed 50% of the airborne lead exposure limit of 0.05 mg/m³; this would trigger the requirement for an employer to file a NOPL and the development and implementation of an exposure control plan and safe work procedures prior to any work being completed. Therefore, for the purposes of this report, paint is

identified as lead based if the total lead concentration is >90 mg/kg as per the federal regulations, and if the paint contains lead concentrations >600 mg/kg, an exposure control plan may be required if the paint is disturbed in such a manner that workers could be exposed to lead at >50% of the exposure limit.

There are no special disposal requirements for materials coated with lead paint unless the lead is found to be leachable in excess of the regulated standard of 5 mg/L in the HW regulations while considering the entire mass of the object the paint is coating.

Radioactive materials are listed under the current Federal TDG Act and Regulations. Substances with a specific radioactivity greater than 70 kBq/kg are considered Class 7 (Radioactive Materials) within the TDG Act and Regulations and must be transported in accordance with the provisions of the TDG Act and Regulations. The Nuclear Safety and Control Act (1997, c.9), Nuclear Substances and Radiation Devices Regulations (SOR/2000-207), advises that radioactive substances that do not contain more than 185 kBq of americium 241 or, where it is in a commercial or industrial facility, more than 740 kBq of americium 241 is considered as a radioactive source under the TDG Act and Regulations.

According to the Canadian Nuclear Society, approximately 30 kBq of radioactive material is contained within a typical smoke detector. Therefore, for a commercial facility, the 740 kBq level may be reached if 25 or more radioactive smoke detection devices are collected and stored together.

WorkSafeBC indicates that employers are required under Section 5.54 of the OHSR to develop an exposure control plan when workers are or may be exposed to airborne silica dust in excess of 50% of the exposure limit. Exposure limits vary depending on the type of silica identified.

6 METHODOLOGY

The following sections outline the specific protocols followed when completing the survey. In general, fieldwork included the following tasks:

- A room-by-room visual survey of the accessible portions of the Site to identify, document and quantify suspected designated substances and hazardous materials; and
- Representative sampling and laboratory analysis of select materials for asbestos and lead content.

The following sections outline the specific protocols followed when completing the survey.

6.1 *Asbestos*

The methodology for completing the asbestos assessment was in accordance with WorkSafeBC guidelines and included the identification of suspect materials and collection of an adequate number of representative samples of these materials. All accessible areas of the Site were observed for possible ACM. Accessible wall cavities and roof spaces were also inspected for the possible presence of vermiculite insulation.

Samples were collected with minimum disturbance and sampling locations repaired, where applicable. Sample locations were marked on the building material in discrete locations; where non-discrete locations were sampled, temporary markings were used to identify the sample locations (i.e., tape and sample bags with IDs). Temporary markings were subsequently removed following sample location photographs.

Samples for laboratory analysis to determine asbestos content were collected in sealable plastic bags, labelled and shipped by courier to International Asbestos Testing Laboratories (IATL) in Mt. Laurel, NJ, USA under Chain of Custody protocols. Analysis of bulk samples for determination of asbestos content was performed using polarized light microscopy (PLM) procedures in accordance with the applicable regulations using EPA 600 R-93/116, 1993 Method.

During the survey, a total of 210 samples were collected for analysis of asbestos content.

6.2 *Lead Paint*

Lead-based paint or surface coatings may be present on structures that need to be cut or ground during renovations. The presence of lead-based paint or surface coatings is not an environmental concern but could pose a potential exposure risk to workers in the event that lead-based paint or surface coatings is burned and/or becomes airborne during renovation activities. As such, sampling

of paint or surface coatings was generally limited to most widely applied, suspected lead-based paint colours on building materials and on larger metal building components that might reasonably require torch cutting during building renovation.

Different paint colours may contain different concentrations of lead; therefore, SNC-Lavalin personnel inspected the Site to determine major paint colour(s) that have been applied to surfaces throughout. The approach was to try to obtain samples from structures that may need to be cut, ground, or sanded during renovation or demolition/deconstruction. Factory painted surfaces were not sampled as the paint is applied in thin layers, making it difficult to obtain a sufficient amount of paint to analyse.

Samples were collected in sealable plastic bags, labelled and submitted to Maxxam Analytics in Burnaby, BC (Maxxam) for analysis of lead in paint. Analysis of bulk samples for determination of metals content was performed using Inductively Coupled Plasma, Mass Spectrometry (ICP-MS) procedures

During the survey, 49 samples were collected and submitted to Maxxam for analysis of total lead in accordance with the applicable regulations.

6.3 Polychlorinated Biphenyls (PCBs)

Historical use of PCBs in electrical equipment manufactured in Canada, such as transformers, fluorescent lamp ballasts and capacitors, was common prior to approximately 1977. The use of PCBs was prohibited by the Canadian Environmental Protection Act in heat transfer and electrical equipment installed after August 1977, and in transformers and capacitors installed after June 1980. However, experience has shown that electrical equipment manufactured previously and held in inventory may still be in use.

The survey included observation of accessible areas of the armoury for items or equipment that could possibly contain PCBs, such as fluorescent light fixtures, HID lamps, and oil-filled electrical equipment.

SNC-Lavalin personnel identified and recorded suspect fluorescent light ballasts and electrical equipment potentially containing PCBs.

6.4 Ozone Depleting Substances

SNC-Lavalin personnel observed the interior and exterior spaces of the Site to identify if air conditioning units, refrigerators, freezers, or other sources of ODS exist. If a unit was identified, the

manufacturer's nameplate (if accessible) was observed to determine the type and amount of refrigerant used.

6.5 *Miscellaneous Solid and Liquid Wastes*

The interior and exterior spaces of the armoury were visually observed to identify the presence of other designated substances and hazardous materials, including miscellaneous solid and liquid wastes. Miscellaneous materials of concern include, but are not limited to, materials in larger means of containment, such as oils or fuels in storage tanks or drums, or chemicals that may be present in smaller household containers, such as paints, solvents, cleaners, etc. Materials of concern were identified, photographed and documented.

6.6 *Liquid Mercury*

Mercury has widespread use in commercial/residential products including electrical switches, barometers and thermometers. It also has many commercial, medical and industrial applications. A potential concern of mercury is its persistence in the environment when released at a landfill following disposal. Special considerations must be taken during the disposal of items containing mercury.

The interior of the building was observed for thermostats that may contain small amounts of liquid mercury. The covers of thermostats found were opened to assess the presence of mercury ampoules.

6.7 *Radiological Sources and/or Substances*

Radioactive sources and/or substances may be present in smoke detection devices.

The accessible areas of the Site were observed for potential radiological sources and/or substances and, if found, SNC-Lavalin compiled an inventory. Any remaining radiological sources and/or substances should be properly disposed of by a qualified contractor prior to renovations or demolition/deconstruction.

6.8 *Silica*

Silica occurs naturally as a crystalline material in rock, sand, concrete and cement, and therefore, is likely present in poured concrete slabs/floors, concrete blocks, mortar, plaster, drywall, acoustic ceiling tiles and ceramic tiles. Crystalline silica is significantly more toxic than amorphous silica; however, both are regulated. Crystalline silica dust can be generated through such processes such as breaking, drilling, hammering, blasting, grinding, crushing or sandblasting silica-containing materials. When breathed in, the crystalline silica dust can cause permanent damage to the lungs.

SNC-Lavalin personnel noted materials at the Site that are suspected of containing silica.

6.9 *Mould and/or Moisture*

SNC-Lavalin personnel observed interior and exterior areas of the Site for the presence of mould and/or moisture. Any suspect areas identified (e.g., beneath sinks or adjacent hot water tanks) were noted and photographed.

7 RESULTS

Details of the results are presented for each regulated material of concern in the following Table 1, below. This information includes recommendations for removal/handling during renovation or demolition/deconstruction activities, where required.

Table 1: Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM)		
Suspect ACM Sampled – Asbestos Identified: <ul style="list-style-type: none"> • A3 (Layer 1) – Drywall joint compound – Room 125. • A4 (Layer 1) – Vinyl floor tiles – off-white with grey streaks – Room 125. • A5 – Drywall joint compound – Room 125. • A15 (Layer 1) – Green vinyl floor tile – Room 127. • A15 (Layer 2) – Black mastic (adhered to Layer 1) – Room 127. • A20 – Grey concrete pipe – Room 127 (crawl space). • A21 – Oakum bell end cast iron pipe fitting filler attached to asbestos-concrete pipe – Room 127 (crawl space). • A23 – Grey gasket – Crawl space Room 127. • A28 (Layer 2) – Drywall joint compound – Room 124. • A29 – Pipe thread sealant on fire line – Room 124. • A34 (Layer 1) – Grey vinyl floor tile – Room 123. • A34 (Layer 2) – Black mastic (adhered to Layer 1) – Room 123. • A35 (Layer 1) – Black mastic (similar to A34) – Room 123. • A35 (Layer 2) – White floor levelling compound – Room 123. • A38 – Grey vinyl floor tile – Room 129. • A40 – Drywall joint compound under vinyl wall covering – Room 130. • A41 – Drywall joint compound in ceiling space – Room 120. • A43 – Grey window putty – Room 120. • A45 (Layer 1) – Grey vinyl floor tile debris located in floor vent – Room 120. • A47 – Drywall joint compound – Room 120. • A49 – Grey window putty – Room 106A above Room 143. 	Analytical Result: <ul style="list-style-type: none"> • 1.1% Chrysotile • 0.75% Chrysotile • 1.3% Chrysotile • 10% Chrysotile • 2.5% Chrysotile • 15% Chrysotile, 10% Crocidolite • 5.1% Amosite • 40% Chrysotile • 1.1% Chrysotile • 0.5% Chrysotile • 8.7% Chrysotile • 0.5% Chrysotile • 0.5% Chrysotile • 1.3% Chrysotile • 6% Chrysotile • 1.2% Chrysotile • 1.2% Chrysotile • 3.5% Chrysotile • 7.2% Chrysotile • 0.75% Chrysotile • 4.1% Chrysotile 	Prior to renovation/demolition, the ACM must be removed by a qualified asbestos removal contractor. Work should be performed in accordance with the OHSR and BC HWR. <p>Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.</p>

Table 1: Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd)		
Suspect ACM Sampled – Asbestos Identified (Cont'd) : <ul style="list-style-type: none"> • A52 – Drywall joint compound – Room 106A above Room 143. • A108 – White ceiling texture – Exterior. • A110 – White wall texture (same as ceiling texture) – Exterior. • A114 – White wall texture (same as ceiling texture) – Exterior. • A116 – White wall texture (same as ceiling texture) – Exterior. • A130 – Grey gasket – Room 137. • A135 (Layer 1) – Off-white vinyl floor tile – Room 132. • A146 – Red mastic on HVAC ducting – Room 136 (crawl space). • A165 – Off-white vinyl floor tile – Room 117. • A168 – Grey window putty – Room 117. • A170 (Layer 1) – Tan vinyl floor tile – Room 119. • A173 – Pipe thread sealant on fire line – Room 143. • A180 (Layer 1) – Grey vinyl floor tile (inside wall compartment) – Room 106B. • A196 (Layer 1) – White vinyl floor tile – Room 112. • A202 (Layer 2) – tar on floor adjacent door step – Room 110. 	Analytical Result: <ul style="list-style-type: none"> • 2.4% Chrysotile • 4.1% Chrysotile • 4.7% Chrysotile • 5.0% Chrysotile • 4.8% Chrysotile • 15% Chrysotile • 4.8% Chrysotile • 1.2% Chrysotile • 1.5% Chrysotile • 10% Chrysotile • 1.4% Chrysotile • 1.4% Chrysotile • 1.2% Chrysotile • 3.6% Chrysotile • 2.4% Chrysotile 	Prior to renovation/demolition, the ACM must be removed by a qualified asbestos removal contractor. Work should be performed in accordance with the OHSR and BC HWR. <p>Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.</p>

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd)		
Suspect ACM Sampled – Asbestos NOT Identified: <ul style="list-style-type: none"> • A1 – Grey cementitious material beneath baseboard – Room 125. • A2 – Black baseboard – Room 125. • A3 (Layer 2) – Tan mastic (A2 adhesive) – Room 125. • A4 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 125. • A4 (Layer 3) – Tan mastic (A2 adhesive) – Room 125. • A6 – Grey window putty – Room 125. • A7 – Ceiling tile – Room 125. • A8 (Layer 1) – Paper insulation backing – Room 125 (ceiling space). • A8 (Layer 2) – Tan wall insulation – Room 125 (ceiling space). • A9 (Layer 1) – Silver pipe insulation – Room 125 (ceiling space). • A9 (Layer 2) – Black tar on pipe insulation – Room 125 (ceiling space). • A10 – White cementitious hole filler in west door – Room 125. • A11 (Layer 1) – Silver pipe insulation – Room 125 (ceiling space). • A11 (Layer 2) – Black tar on pipe insulation – Room 125 (ceiling space). • A12 – Grey wall mortar patch for piping/wiring – Room 125 (ceiling space). • A13 – Ceiling tile – Room 125. • A14 – Grey putty (loose piece) – Room 125 (ceiling space) • A16 (Layer 1) – Black baseboard – Room 127. • A16 (Layer 2) – Brown mastic (Layer 1 adhesive) – Room 127. • A17 (Layer 1) – Black baseboard – Room 127. • A17 (Layer 2) – White mastic (Layer 1 adhesive) – Room 127. 	Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos 	No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd)		
Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> • A18 – Red mastic over doorway – Room 127. • A19 – Pipe thread sealant – Room 127 (crawl space). • A22 – Pipe thread sealant – Room 127 (crawl space). • A24 – Grey sill gasket – Room 127 (crawl space). • A25 – Drywall joint compound between plywood joints – Room 127. • A26 – Drywall joint compound on ceiling patch – Room 124. • A27 – Ceiling tile – Room 124. • A28 (Layer 1) – Black baseboard – Room 124. • A28 (Layer 3) – White mastic on baseboard (Layer 1 adhesive) – Room 124. • A30 – Drywall joint compound in skylight – Room 124. • A31 – Ceiling tile (suspended) – Room 123. • A32 – Ceiling tile (at top of ceiling space) – Room 123. • A33 – Yellow glue under carpet – Room 123 • A36 – White mastic between wall panels (north wall) – Room 123. • A37 – Ceiling tile – Room 129. • A39 – Vinyl wall covering – Room 129. • A42 – Drywall joint compound – Room 128. • A44 – Drywall joint compound – Room 120. • A46 – Grey cementitious on base of east door – Room 120. • A48 – Grey grout – Room 130. • A50 – White pipe insulation wrap (ceiling space) – Room 106A above Room 143. • A51 – Ceiling tile – Room 106A above Room 143. 	Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos 	No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd)		
Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> • A95 (Layer 1) – Grey mastic adjacent window on west side of raised portion of Roof. • A95 (Layer 2) – Clear mastic adjacent window on west side of raised portion of Roof. • A96 – Black mastic around electrical conduit entering building on west side of raised portion of Roof. • A97 – Dark brown mastic on south end of sloped metal roofing west of raised portion of Roof. • A98 – White mastic on security camera mount – Roof over Room 101. • A99 – Black mastic on sloped metal roof west of raised portion of Roof. • A100 – Tar paper beneath sloped metal roof west of raised portion of Roof. • A101 – Tan mastic between foam and wood supports for metal conduit – east portion of raised section of Roof. • A102 – Mastic around lead pipe opening for ACU6 wiring – Roof. • A103 – Tar paper (bottom of roof profile) – east of ACU7. • A104 (Layer 1) – Black/grey shingle – east of ACU7 (roof profile). • A104 (Layer 2) – Black roof material (roof profile). • A104 (Layer 3) – Black tar (roof profile). • A104 (Layer 4) – Brown fibrous roof material (roof profile). • A105 – Grey mastic around steel pipe opening for ACU8 wiring – Roof. • A106 – Brown tar paper beneath metal roof siding – east side of building outside Room 107 (exterior). 	Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos 	No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd)		
Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> • A107 – Black tar on foundation – southwest corner of building (exterior). • A109 (Layer 1) – White texture waterproof membrane on building foundation – west side outside Room 133 (exterior). • A109 (Layer 2) – Black tar waterproof membrane. • A111 – White mastic on metal conduit entering Room 127 (exterior). • A112 – tar paper under textured wood siding – southwest corner of building (exterior). • A113 – White window mastic – southwest corner of building outside Room 125 (exterior). • A115 – Wall texture coat – west side of building (exterior). • A117 – Grey baseboard – Room 138. • A118 – Yellow mastic (A117 adhesive) – Room 138. • A119 – Brown mastic (A117 adhesive) – Room 138. • A120 (Layer 1) – Grey transition strip – Room 138. • A120 (Layer 2) – Tan mastic (Layer 1 adhesive) – Room 138. • A121 – Tan mastic plywood knot hole filler – Room 138 • A122 – Red mastic around conduit over door – Room 138. • A123 (Layer 1) – Red mastic around conduit in northeast corner – Room 138. • A123 (Layer 2) – Off-White foam hole filler around conduit in northeast corner – Room 138. • A124 – Pipe thread sealant on fire line – Room 138. • A125 – Drywall joint compound – Room 138. 	Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos 	No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd)		
Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> • A200 (Layer 1) – Tan mastic (carpet adhesive above vinyl floor tile) – Room 111. • A200 (Layer 2) – Grey vinyl floor tile – Room 111. • A200 (Layer 3) – Black mastic (Layer 2 adhesive) – Room 111. • A201 – Fiberboard wall covering (similar to ceiling tile) – Room 110B. • A202 (Layer 1) – Black floor tar – Room 110B. • A203 – White floor leveling compound – Room 110B. • A204 – Tan putty around door – Room 110B. • A205 – Grey leveling compound under carpet – Room 151B. • A206 – Grey baseboard – Room 151B. • A207 – Tan mastic (A206 adhesive) – Room 151B. • A208 – Drywall joint compound between sheets of plywood – Room 107. • A209 – Red mastic on north wall (east corner) – Room 107. • A210 – Drywall joint compound – Room 110A. 	Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos 	No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.
Suspect ACMs not sampled: <ul style="list-style-type: none"> • Not all wall cavities could be inspected; therefore, there is the potential for vermiculite insulation to be present within wall cavities. • Fire doors to the entrances of Rooms 137 and 138 may contain asbestos-containing filler material. • Electrical wiring insulation, gaskets and insulating panels throughout the building. • Suspect asbestos-concrete pipes below ground. 	Analytical Result: <ul style="list-style-type: none"> • N/A • N/A • N/A • N/A 	Inaccessible areas suspect of containing ACMs should be inspected prior to renovation/deconstruction activities. All suspect ACMs not sampled should be sampled for asbestos content and managed accordingly.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
LEAD PAINT (mg/kg)		
Suspect lead-based paint sampled: <ul style="list-style-type: none"> • P1 – Light brown / blue door – Room 125. • P2 – Brown / blue door / window frames – Room 125. • P3 – White wall – Room 125. • P4 – Green door frame – Room 127. • P5 – Grey wall panel – Room 127. • P6 – White door frame – Room 123. • P7 – Blue wall – Room 123. • P8 – Light brown door – Room 129. • P9 – Light brown / blue door – Room 130. • P10 – Beige trim – Room 120. • P11 – Light brown wall – Room 120. • P12 – Off-white – Room 106A (above 143). • P13 – White – Room 106A (above 143). • P14 – Light blue / white door frame – Room 109. • P15 – Light blue walls – Room 151A. • P16 – Beige wall – Room 105A. • P17 – Yellow paint on steel pipe – Roof. • P18 – Grey paint on wall of raised portion – Roof. • P19 – White paint on soffit of raised portion – Roof. • P20 – Black paint on ladder to raised portion – Roof. • P21 – Dark brown window trim on East side of raised portion – Roof. • P22 – White on tar on foundation – Exterior. • P23 – Brown – Exterior. • P24 – Blue – Exterior. 	Analytical Result: <ul style="list-style-type: none"> • <u>5,700 mg/kg</u> • <u>8,350 mg/kg</u> • <u>788 mg/kg</u> • <u>8,480 mg/kg</u> • <u>990 mg/kg</u> • < 3 mg/kg • < 15 mg/kg • < 3 mg/kg • <u>1,780 mg/kg</u> • <u>187 mg/kg</u> • < 3 mg/kg • <u>1,570 mg/kg</u> • <u>1,350 mg/kg</u> • <u>461 mg/kg</u> • < 3 mg/kg • 50.4 mg/kg • <u>18,800 mg/kg</u> • <u>732 mg/kg</u> • <u>34,500 mg/kg</u> • <u>337 mg/kg</u> • <u>3,430 mg/kg</u> • <u>4,220 mg/kg</u> • < 15 mg/kg • <u>173 mg/kg</u> 	Lead paint was identified containing >90 mg/kg in the majority of samples. If cutting torch, grinding equipment or other work methods are used on the painted areas of the structures that could mobilize lead dust or fumes then high risk individuals such as pregnant women or children should be kept out of the work area. Most of the paint samples were also found to be containing lead concentrations ≥600 mg/kg . Therefore, an exposure control plan must be implemented if work activities could generate lead dust or fumes. A fog nozzle to wet the area should be used to reduce particles during the demolition process.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
LEAD PAINT (mg/kg) (Cont'd)		
Suspect lead-based paint sampled: <ul style="list-style-type: none"> • P25 – Dark brown door frame– Exterior. • P26 – Light grey / white on concrete foundation – Exterior. • P27 – Pink wall and ceiling – Room 128B. • P28 – Grey floor – Room 138. • P29 – Beige wall – Room 138. • P30 – Dark grey plywood wall – Room 138. • P31 – Light grey plywood wall – Room 138. • P32 – Grey plywood wall – Room 138. • P33 – Beige wall – Room 137. • P34 – Grey primer on wall in ceiling space – Room 142. • P35 – Green door frame – Room 135. • P36 – Light brown door frame– Room 132. • P37 – Red / brown door paint – Room 143. • P38 – Beige wall – Room 143. • P39 – Brown door frame paint – Room 143. • P40 – Red window frame (west wall) – Room 106B. • P41 – Brown door to wall cabinet – Room 106B. • P42 – Yellow paint in wall cabinet – Room 106B. • P43 – Beige wall paint – Room 106B. • P44 – Yellow door frame paint – Room 112. • P45 – White trim paint in ceiling space – Room 113. • P46 – Beige – collected from steel pipe – Room 110B. • P47 – Light brown wall – Room 151B. • P48 – Beige – collected from steel pipe – Room 107. 	Analytical Result: <ul style="list-style-type: none"> • <u>4,080 mg/kg</u> • <u>2,500 mg/kg</u> • <u>370 mg/kg</u> • <u>2,110 mg/kg</u> • <u>745 mg/kg</u> • 19.5 mg/kg • < 3 mg/kg • < 24 mg/kg • <u>524 mg/kg</u> • <u>130 mg/kg</u> • <u>1,170 mg/kg</u> • <u>4,810 mg/kg</u> • < 3 mg/kg • < 3 mg/kg • < 3 mg/kg • <u>705 mg/kg</u> • <u>952 mg/kg</u> • <u>5,780 mg/kg</u> • 21.5 mg/kg • <u>396 mg/kg</u> • 40.1 mg/kg • <u>667 mg/kg</u> • < 3 mg/kg • < 9 mg/kg 	Lead paint was identified containing >90 mg/kg in the majority of samples. If cutting torch, grinding equipment or other work methods are used on the painted areas of the structures that could mobilize lead dust or fumes then high risk individuals such as pregnant women or children should be kept out of the work area. Most of the paint samples were also found to be containing lead concentrations >600 mg/kg . Therefore, an exposure control plan must be implemented if work activities could generate lead dust or fumes. A fog nozzle to wet the area should be used to reduce particles during the demolition process.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
LEAD PAINT (mg/kg) (Cont'd)		
Suspect lead-based paint sampled: <ul style="list-style-type: none"> • P49 – Light grey door frame – Room 115. 	Analytical Result: <ul style="list-style-type: none"> • < 18 mg/kg 	No renovation/pre-demolition requirements necessary.
POLYCHLORINATED BIPHENYLS		
Fluorescent and HID light ballasts were identified/suspected in the following areas: <ul style="list-style-type: none"> • Throughout the interior and exterior of the building. 	<ul style="list-style-type: none"> • Approximately 250 fluorescent lights ballasts were identified (throughout the building). • Approximately 15 HID light ballasts were identified (Rooms 106A, 106B and 102). • Approximately 6 HID light ballasts were identified on the roof facing air side. 	Prior to renovation/demolition remove all light ballasts and/or capacitors. Inspect for PCB-containing and/or suspect PCB-containing ballasts as per Environment Canada publication, <i>Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2, August 1991.</i> Place known or suspect PCB-containing ballasts in an 18-gauge steel painted drum with a close fitting removable steel lid on top of a gasket of PCB-resistant material. The drum is to be supplied by the demolition contractor. Drums should be disposed of in Canada in accordance with HWR.

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
OZONE DEPLETING SUBSTANCES		
<p>A total of 23 air conditioning units, water cooling units and refrigerators/freezers were identified on the Site and include the following:</p> <p>Room 162</p> <ul style="list-style-type: none"> Ice Maker. Refrigerator (left unit on west wall). Freezer (right unit on west wall). Air conditioning unit (ceiling space). <p>Room 161</p> <ul style="list-style-type: none"> Cooler (small on south wall, west side). Drink cooler (north wall, east side). Freezer (east wall). <p>Room 151B</p> <ul style="list-style-type: none"> Water cooler. <p>Room 110A</p> <ul style="list-style-type: none"> Refrigerator. <p>Room 113</p> <ul style="list-style-type: none"> Water cooler. Refrigerator. <p>Room 116A</p> <ul style="list-style-type: none"> Refrigerator. 	<ul style="list-style-type: none"> 9 oz of R404a refrigerant 21 oz of R134a refrigerant 27 oz of R404a refrigerant 13.1 oz of R410a refrigerant <ul style="list-style-type: none"> 9 oz of R134a refrigerant 17 oz of R22 refrigerant (ODS) No identification tag <ul style="list-style-type: none"> 1.23 oz of R134a refrigerant <ul style="list-style-type: none"> 1.76 oz of R134a refrigerant <ul style="list-style-type: none"> 1.66 oz of R134a refrigerant Tag inaccessible <ul style="list-style-type: none"> 1.59 oz of R134a refrigerant 	<p>ODS refrigerants (i.e., R22) should be recovered by qualified personnel and disposed of in accordance with Regulations made under CEPA.</p> <p>Non-ODS refrigerants (R134a and R404a) were identified on the site which contains hydrofluorocarbons (HFC) that are regulated in the Federal Halocarbon Regulations as per item 11 (HFC) of Schedule 1 – List of Halocarbons. As a result, halocarbon-containing Non-ODS refrigerants should be recovered by qualified personnel and disposed of in accordance with Federal Regulations.</p>

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
OZONE DEPLETING SUBSTANCES (Cont'd)		
<p><u>Room 116B</u> Freezer.</p> <p><u>Room 134</u></p> <ul style="list-style-type: none"> • Refrigerator. <p><u>Room 136</u></p> <ul style="list-style-type: none"> • Wall mounted air conditioning unit. <p><u>Room 140</u></p> <ul style="list-style-type: none"> • Water cooler (white). • Water cooler (black). • Refrigerator. <p><u>Roof</u></p> <ul style="list-style-type: none"> • Air Conditioning Unit 2 • Air Conditioning Unit 4 • Air Conditioning Unit 5 • Air Conditioning Unit 6 • Air Conditioning Unit 7 • Air Conditioning Unit 8 	<ul style="list-style-type: none"> • 4.2 oz of R134a refrigerant • No identification tag • 22.9 oz of R410a refrigerant • No refrigerant listed on ID tag • 32 g of R134a refrigerant • 75 g of R134a refrigerant • 7 lbs 0 oz of R22 refrigerant • 4 lbs 12 oz of R22 refrigerant • 7 lbs 0 oz of R22 refrigerant • 8 lbs 6 oz of R22 refrigerant • 7 lbs 9 oz of R22 refrigerant • 3 lbs 3 oz of R22 refrigerant 	<p>ODS refrigerants (i.e., R22) should be recovered by qualified personnel and disposed of in accordance with Regulations made under CEPA.</p> <p>Non-ODS refrigerants (R134a and R404a) were identified on the site which contains hydrofluorocarbons (HFC) that are regulated in the Federal Halocarbon Regulations as per item 11 (HFC) of Schedule 1 – List of Halocarbons. As a result, halocarbon-containing Non-ODS refrigerants should be recovered by qualified personnel and disposed of in accordance with Federal Regulations.</p>

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
MISCELLANEOUS SOLID AND LIQUID WASTES		
<ul style="list-style-type: none"> • Lead-based batteries were identified in the following Rooms: <ul style="list-style-type: none"> ➤ 125 – Potential lead-based batteries in the fire control box on the north wall. ➤ 127 – Two (2) lead-based batteries (one in each fire control box on the west wall); eight (8) lead-containing batteries (car sized) on the south wall; one (1) lead-based battery in the control box on the east wall. ➤ 138 – Additional lead-based batteries may be present in other electrical equipment and/or control boxes that were not accessible during the survey. • Approximately five (5) potential lead-based batteries may be present in the emergency lighting boxes located in the following Rooms: <ul style="list-style-type: none"> ➤ 102 – North wall. ➤ 109 – South wall. ➤ 106B – West wall, north of the front entrance. ➤ 112 – East wall over the south doorway. ➤ 127 – East wall, southeast corner. • Soldering equipment located in Room 133. • Potential lead-containing bell and spigot cast iron pipe joint packing was identified in the crawlspace of Room 127. 	<ul style="list-style-type: none"> • Potential for lead containing material. • Lead containing material. • Potential for lead containing material. • Potential for lead containing material. • Potential for lead containing material. • Potential for lead containing material. 	<p>These materials must be removed prior to demolition. However, if these materials are to be disposed of or recycled, it is the responsibility of the qualified contractor to correctly identify and characterize the wastes observed and dispose of or recycle appropriately.</p>

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
SOLID AND LIQUID WASTES (Cont'd)		
<ul style="list-style-type: none"> • Copper piping solder joints located throughout the building. • Potential lead-containing roof vent pipes located on the exterior roof. • Approximately 12 fire extinguishers were identified in Rooms 105B, 107, 110, 114, 116A, 124, 127, 135, 136, 138, and 162. • Various cleaning supplies located in Room 128A (janitor's storage room). • Flammable storage box in Room 135 containing various paints, oils, propane, etc. • Nine (9) Sinclair canisters (appeared empty – unknown contents [no additional labels]) in Room 135. 	<ul style="list-style-type: none"> • Potential for lead containing material. • Potential for lead containing material. 	<p>These materials must be removed prior to demolition. However, if these materials are to be disposed of or recycled, it is the responsibility of the qualified contractor to correctly identify and characterize the wastes observed and dispose of or recycle appropriately.</p>
LIQUID MERCURY		
<ul style="list-style-type: none"> • Four (4) mercury-containing thermostats were observed in the building at the following locations: <ul style="list-style-type: none"> ➤ Room 110 – Two (2) thermostats on the north wall (northeast corner). ➤ Room 140 – East wall. ➤ Room 142 – South wall. 	<ul style="list-style-type: none"> • Two (2) ampoules of mercury; one ampoule in each thermostat. • One (1) ampoule of mercury. • One (1) ampoule of mercury. 	<p>The mercury containing ampoules must be removed prior to renovation/demolition and reused, recycled or disposed of in accordance with the BC HWR and applicable Regulations made under CEPA.</p>
RADIOLOGICAL SOURCES AND SUBSTANCES		
<p>No suspect radiological sources or substances were observed.</p>	<ul style="list-style-type: none"> • None identified. 	<p>No renovation/pre-demolition requirements necessary.</p>

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

Issue / Location	Results	Renovation/Pre-Demolition Requirement
SILICA		
Silica may be present throughout the building in the following materials: <ul style="list-style-type: none"> • Concrete floors • Ceramic tiles • Ceiling tiles • Mortar • Drywall 	<ul style="list-style-type: none"> • N/A 	If the material is to be cut, ground, drilled or broken up during renovation/demolition, then airborne silica particles may be released. Therefore, an exposure control plan must be implemented if work activities could generate silica dust.
MOULD AND/OR MOISTURE		
None was identified.	<ul style="list-style-type: none"> • N/A 	No renovation/pre-demolition requirements necessary.

8 NOTICE TO READER

This report has been prepared by SNC-Lavalin Inc. (SNC-Lavalin) for Canada, who has been party to the development of the scope of work for this project and understands its limitations¹. Copyright of this report vests with Her Majesty the Queen in Right of Canada. This report was prepared in accordance with a services contract between SNC-Lavalin and Canada, including General Conditions 2035 of the Standard Acquisition Clauses and Conditions (SACC) Manual.

This report is intended to provide information to Canada to assist it in making business decisions. SNC-Lavalin is not a party to the various considerations underlying the business decisions, and does not make recommendations regarding such business decisions.

The findings, conclusions and recommendations in this report have been developed in a manner consistent with the level of skill normally exercised by environmental professionals currently practising under similar conditions in the area. The findings contained in this report are based, in part, upon information provided by others. If any of the information is inaccurate, modifications to the findings, conclusions and recommendations may be necessary.

The findings, conclusions and recommendations presented by SNC-Lavalin in this report reflect SNC-Lavalin's best judgement based on the site conditions at the time of the site inspection on the date(s) set out in this report and on information available at the time of preparation of this report. Substances other than those described may exist within the site, reported substance parameters may exist in areas of the site not investigated, and concentrations of substances greater or less than those reported may exist between sample locations.

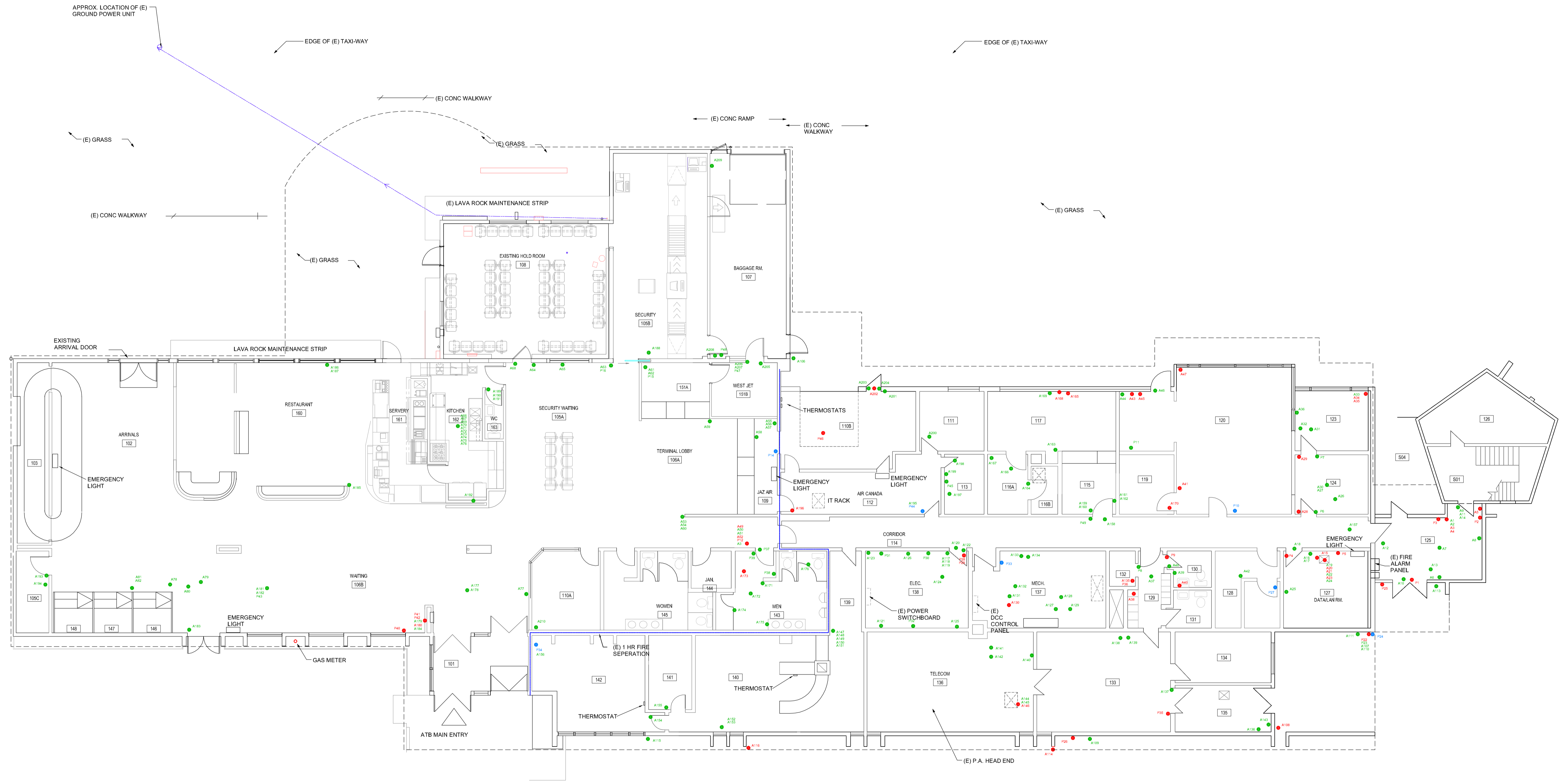
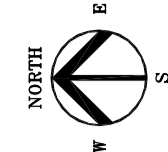
The findings and conclusions of this report are valid only as of the date of this report. If site conditions change, new information is discovered, or unexpected site conditions are encountered in future work, including excavations, borings, or other studies, the findings, conclusions and/or recommendations of this report should be re-evaluated. It is recommended that users of this report should engage a suitably qualified professional to assist in interpreting the significance, if any, of the findings.

¹ © Her Majesty the Queen in Right of Canada (2015)

APPENDIX I

Drawings:

- 636746-BM1 – Sample Location Plan – First Floor
- 636746-BM2 – Sample Location Plan – Roof



LEGEND

- A13 ● ASBESTOS SAMPLE WITH CONCENTRATION LESS THAN 0.5%
- A14 ● ASBESTOS SAMPLE WITH CONCENTRATION GREATER THAN OR EQUAL TO 0.5%
- P16 ● PAINT SAMPLE WITH LEAD CONCENTRATION LESS THAN OR EQUAL TO 50 mg
- P23 ● PAINT SAMPLE WITH LEAD CONCENTRATION GREATER THAN 50 mg AND LESS THAN 600 mg
- P17 ● PAINT SAMPLE WITH LEAD CONCENTRATION GREATER THAN OR EQUAL TO 600 mg

NOTES

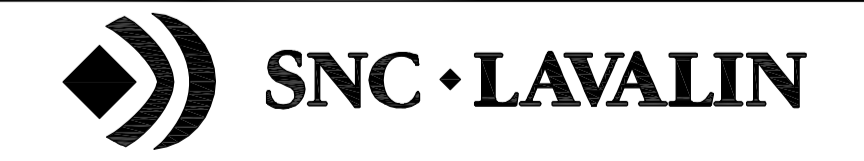
1. ORIGINAL DRAWING IN COLOUR.
2. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED ON SITE. NOT ALL UTILITIES MAY BE SHOWN.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION

REVISIONS

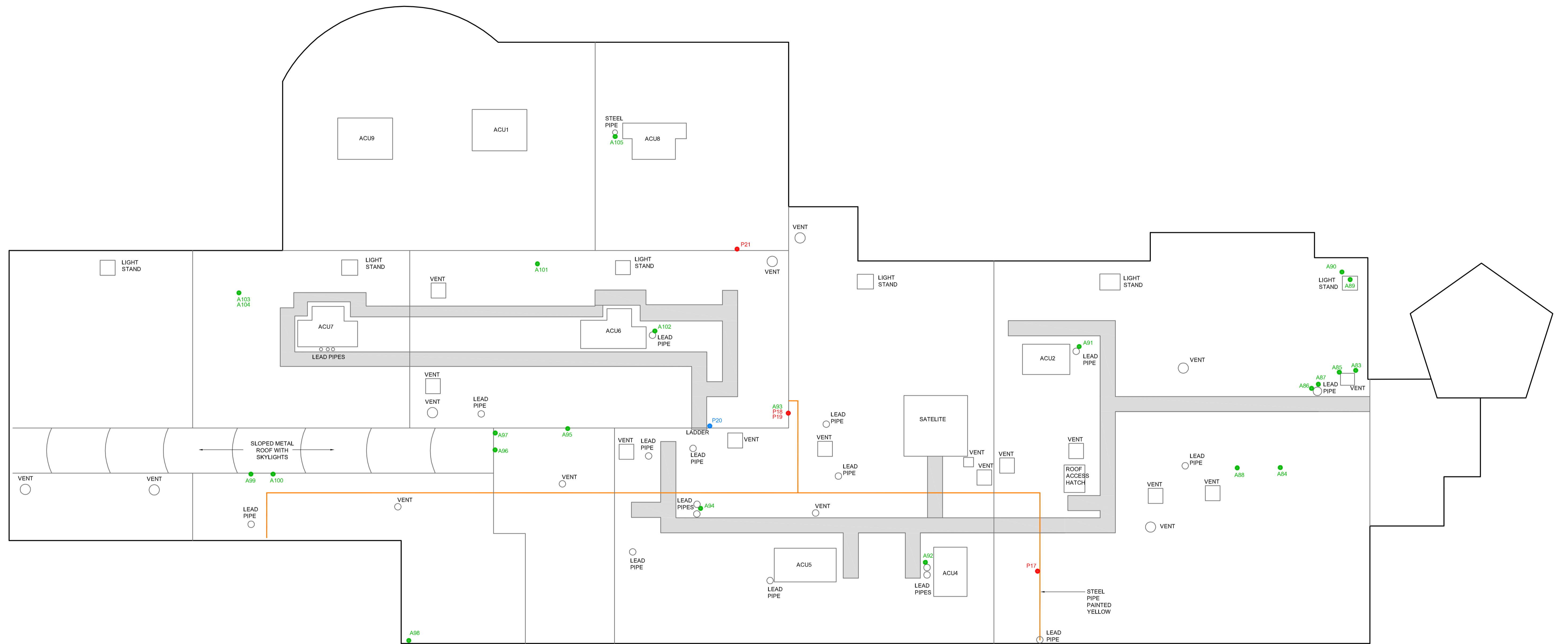
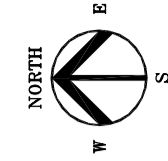
REV.	DATE	DESCRIPTION	BY	CHK	TOD
0	2016-03-31	ISSUED TO CLIENT	AJK	TDD	



CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES
 PROJECT LOCATION: 109-3000 AIRPORT ROAD PENTICTON, BC

SAMPLE LOCATION PLAN - FIRST FLOOR

DWN BY: AJK SCALE: 1:1000 DATE: 2016-03-03 DWG No: 0
 CHK'D: TDD PLOT: 20160502.1023 CADFILE: 636476-BM3 636476-BM1



**SAMPLE LOCATION PLAN
- ROOF PLAN**

LEGEND

- A13 ● ASBESTOS SAMPLE WITH CONCENTRATION LESS THAN 0.05
- A14 ● ASBESTOS SAMPLE WITH CONCENTRATION GREATER THAN OR EQUAL TO 0.05
- P18 ● PAINT SAMPLE WITH LEAD CONCENTRATION LESS THAN OR EQUAL TO 50 mg
- P23 ● PAINT SAMPLE WITH LEAD CONCENTRATION GREATER THAN 50 mg AND LESS THAN 600 mg
- P17 ● PAINT SAMPLE WITH LEAD CONCENTRATION GREATER THAN OR EQUAL TO 600 mg



NOTES

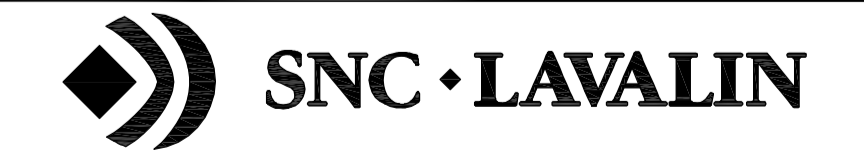
1. ORIGINAL DRAWING IN COLOUR.
2. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED ON SITE. NOT ALL UTILITIES MAY BE SHOWN.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION

REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK
0	2016-03-31	ISSUED TO CLIENT	AJK	TDD



CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES	PROJECT LOCATION: 109-3000 AIRPORT ROAD PENTICTON, BC		
TITLE: SAMPLE LOCATION PLAN - ROOF PLAN			
DWN BY: AJK	SCALE: 1:1000	DATE: 2016-03-03	DWG No: 0
CHK'D: TDD	PLOT: 20160502.1024	CADFILE: 636476-BM3	636476-BM2

APPENDIX II

Photographs



Photograph 1: West side of building (front entrance on right) – Facing southeast.



Photograph 2: North side of building – Facing east.



Photograph 3: Front (west) side of building – Facing north.



Photograph 4: South end of building – Facing north.



Photograph 5: East side of building (Rooms 105B/107 on left, new hold room on right) – Facing northwest.



Photograph 6: Airside (east) arrivals entrance – Facing northwest.



Photograph 7: Roof – Facing north towards raised portion of roof.



Photograph 8: Roof – Facing south (standing west of raised portion of roof).



Photograph 9: Raised portion of roof – Facing north..



Photograph 10: Room 106A – Air Canada and West Jet counters – Facing southeast.



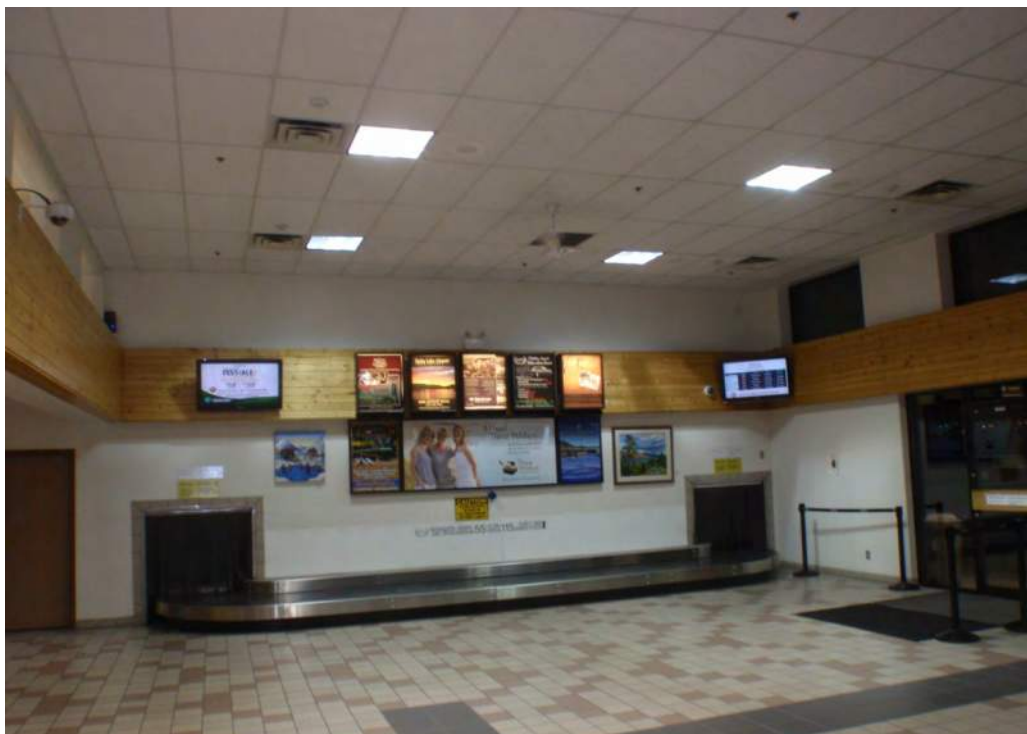
Photograph 11: Room 106B (north of entrance and west of restaurant) – Facing south.



Photograph 12: Wall compartment in Room 106B (south wall), north of entrance – Facing southwest.



Photograph 13: Room 106B – Facing north (arrivals area in right of photo).



Photograph 14: Room 102 (arrivals) – Facing north towards baggage claim carousel.



Photograph 15: Room 160 (restaurant) – Facing southeast.



Photograph 16: Room 105A (security waiting area) – Facing east.



Photograph 17: Room 127 crawlspace with asbestos-containing concrete pipe.



Photograph 18: Room 136 crawlspace.



Photograph 19: Asbestos-containing concrete pipe (capped) on west side of building.



Photograph 20: Room 135 – Flammable storage box.



Photograph 21: Room 135 Sinclair canisters – unknown contents.



Photograph 22: Typical lead-acid battery in fire control box (Room 127).



Photograph 23: Room 127 lead-containing batteries.



Photograph 24: Typical emergency light with potentially lead-containing battery (Room 127).



Photograph 25: Typical mercury-containing thermostat (Room 142).



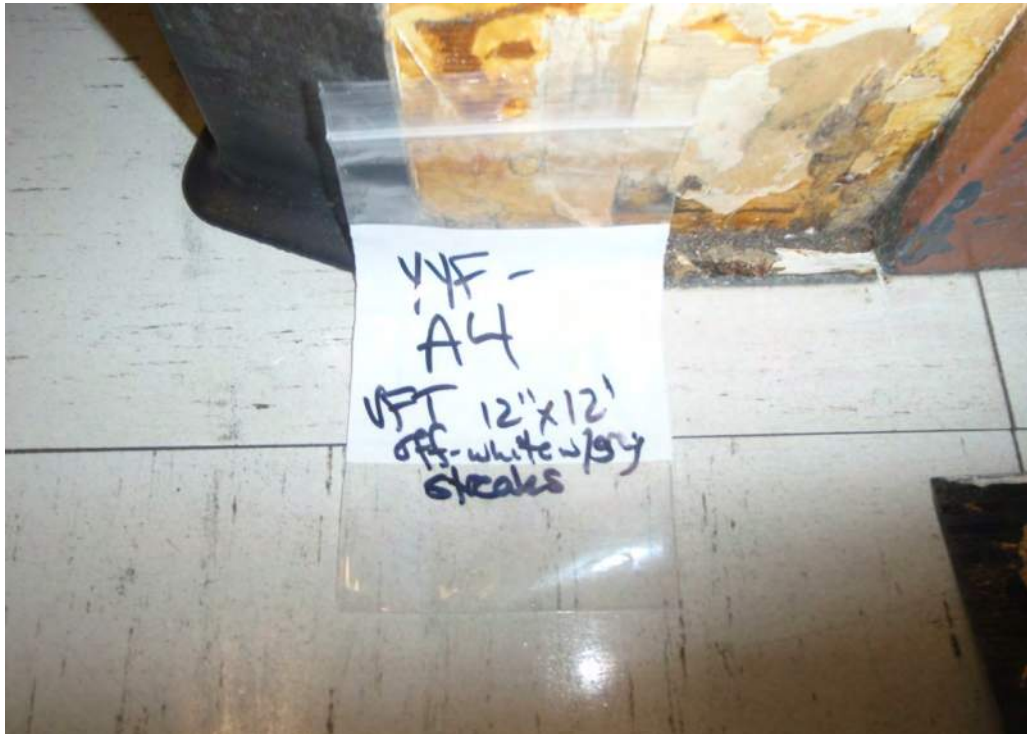
Photograph 26: Typical rooftop air conditioning unit.



Photograph 27: Typical potential lead-containing roof vent pipe.



Photograph 28: Asbestos-containing drywall joint compound in Room 125 (**Sample A3**).



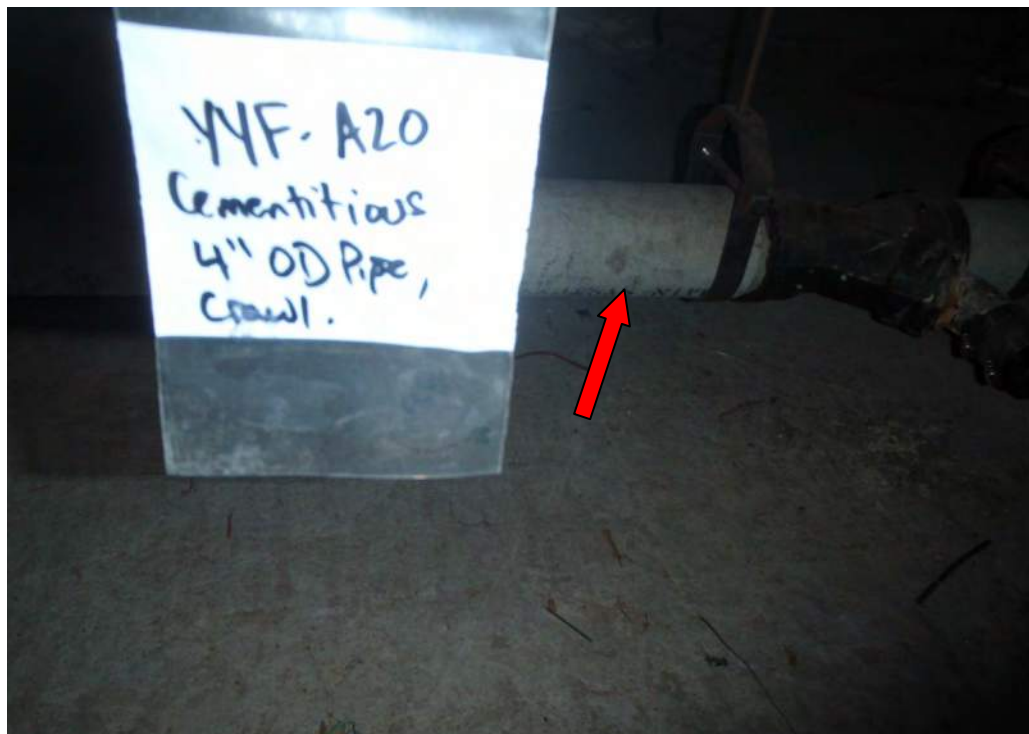
Photograph 29: Asbestos-containing light grey (off-white with grey streaks) vinyl floor tiles in Room 125 (Sample A4).



Photograph 30: Asbestos-containing drywall joint compound in Room 125 (Sample A5).



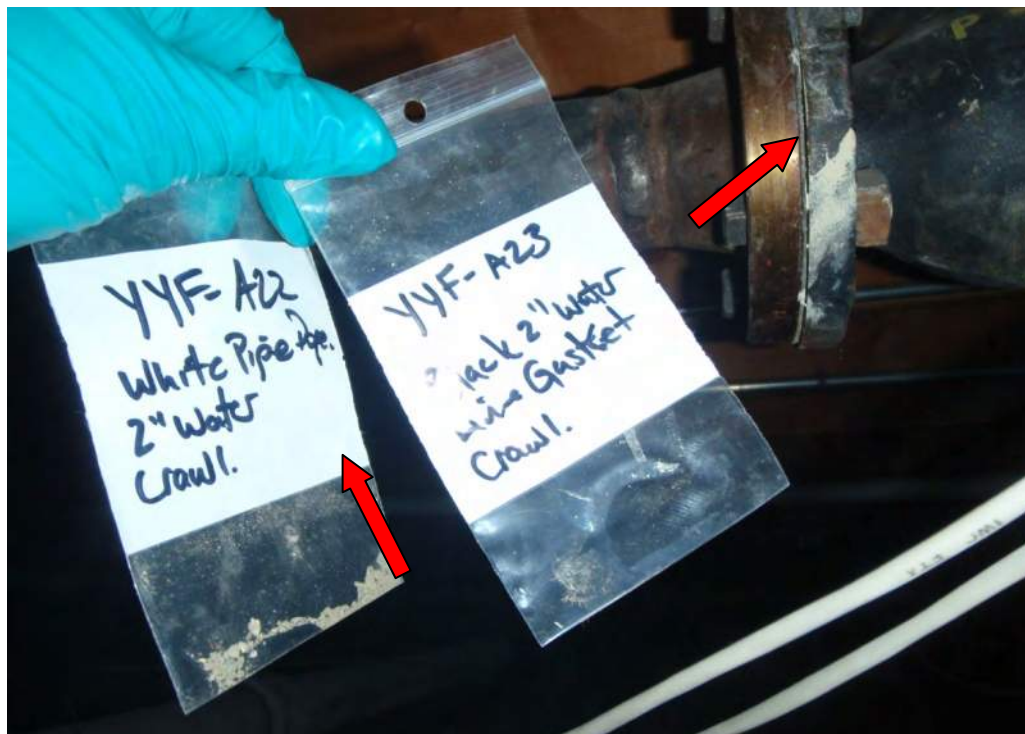
Photograph 31: Asbestos-containing green vinyl floor tiles (**Sample A15**).



Photograph 32: Asbestos-containing concrete pipe in crawlspace beneath Room 127 (**Sample A20**).



Photograph 33: Asbestos-containing bell and spigot joint filler (**Sample A21**).



Photograph 34: Asbestos-containing grey gasket in crawlspace beneath Room 127 (**Sample A23**) and non-asbestos containing white pipe sealant (**Sample A22**).



Photograph 35: Asbestos-containing drywall joint compound in Room 124 (**Sample A28**).



Photograph 36: Asbestos-containing pipe thread sealant on fire line in Room 124 (**Sample A29**).



Photograph 37: Asbestos-containing grey vinyl floor tile (**Sample A34**) and associated black mastic (**Sample A35**) over white floor leveling compound (**Sample A35 – Layer 2**) in Room 123.



Photograph 38: Asbestos-containing grey vinyl floor tile (**Sample A38**).



Photograph 39: Asbestos-containing drywall joint compound in Room 130 (**Sample A40**).



Photograph 40: Asbestos-containing drywall joint compound in ceiling space of Room 120 (**Sample A41**).



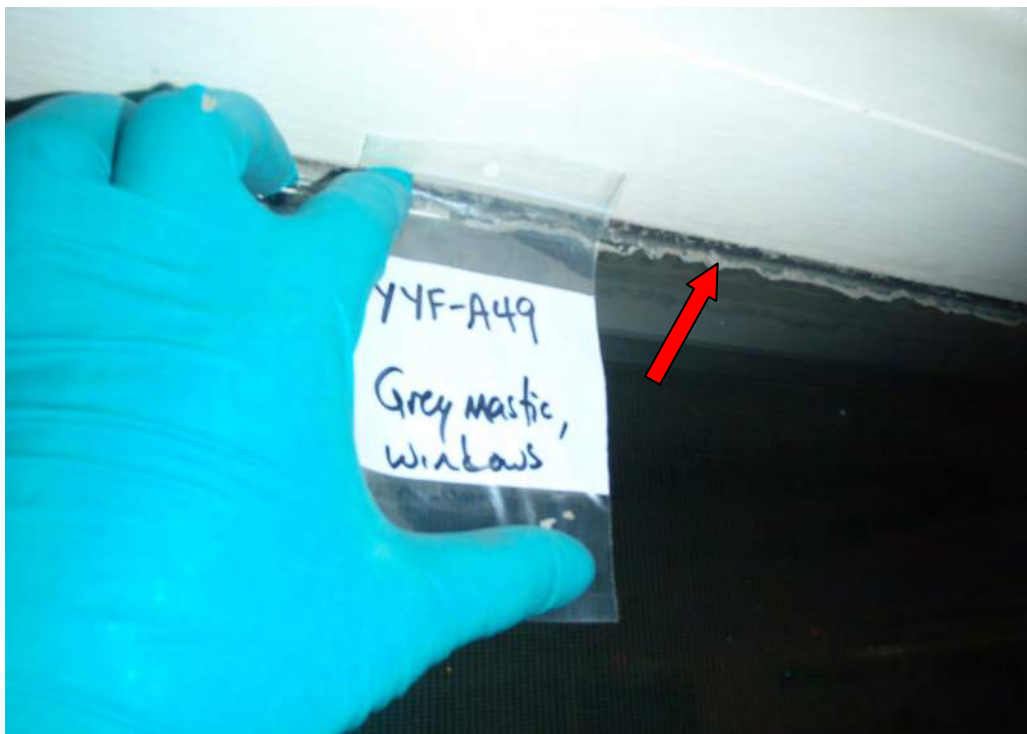
Photograph 41: Asbestos-containing grey window putty in Room 120 (Sample A43).



Photograph 42: Asbestos-containing grey vinyl floor tile debris located in the floor vent in Room 120 (Sample A45).



Photograph 43: Asbestos-containing drywall joint compound in Room 120 (**Sample A47**).



Photograph 44: Asbestos-containing grey window putty on upper window in Room 106A above Room 143. (**Sample 49**).



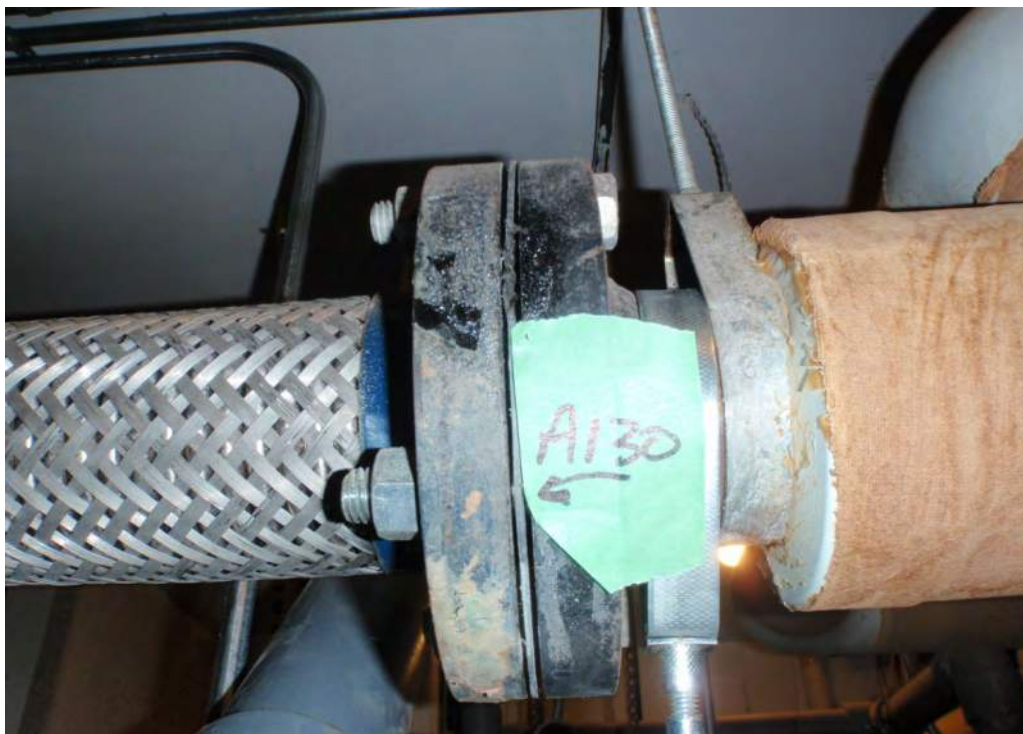
Photograph 45: Asbestos-containing drywall joint compound in Room 106A above Room 143 (**Sample A52**).



Photograph 46: Asbestos-containing exterior ceiling texture on south end of building (**Sample A108**).



Photograph 47: Asbestos-containing exterior wall texture on west side of building (**Sample A114 and Sample A116**).



Photograph 48: Asbestos-containing grey pipe gasket in Room 137 (**Sample A130**).



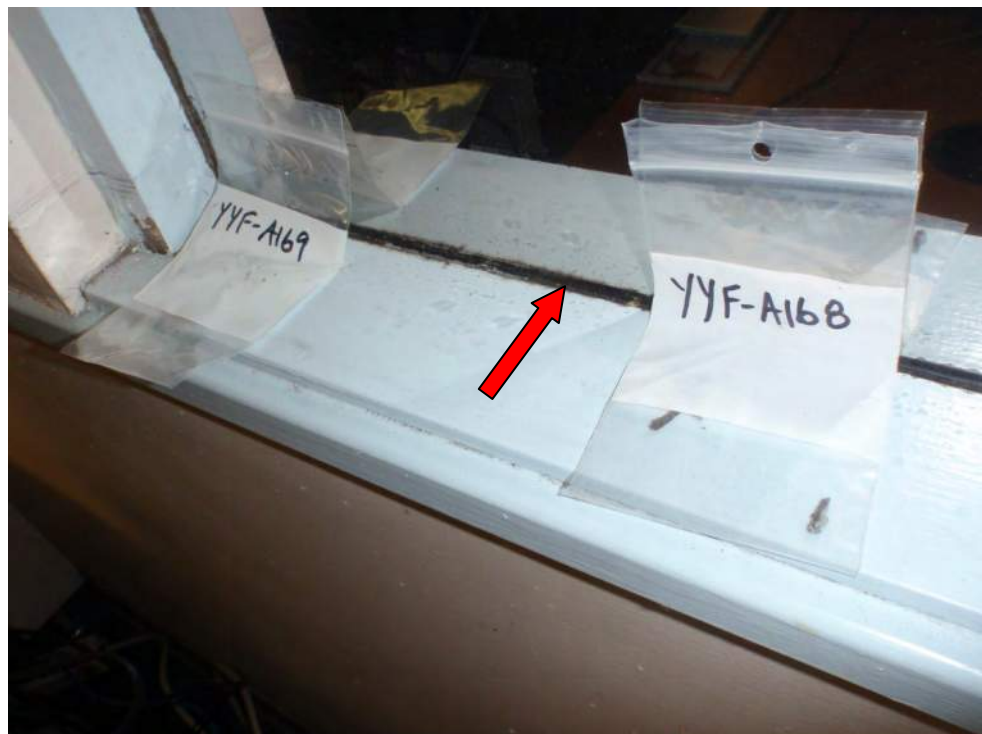
Photograph 49: Asbestos-containing off-white vinyl floor tile in Room 117 (**Sample A135**).



Photograph 50: Asbestos-containing red mastic on HVAC ducting in crawlspace beneath Room 136 (**Sample A146**).



Photograph 51: Asbestos-containing off-white vinyl floor tile in Room 117 (**Sample A165**).



Photograph 52: Asbestos-containing grey window putty in Room 117 (**Sample A168**).



Photograph 53: Asbestos-containing tan vinyl floor tile in Room 119 (**Sample A170**).



Photograph 54: Asbestos-containing pipe thread sealant on fire line in Room 143 (**Sample A173**).



Photograph 55: Asbestos-containing grey vinyl floor tile located inside wall compartment in Room 106B (Sample A180).



Photograph 56: Asbestos-containing white vinyl floor tile in Room 112 (Sample A196).



Photograph 57: Asbestos-containing tar on floor adjacent door step in Room 110 (**Sample A202**).



Photograph 58: Typical fire door to Room 137 (not sampled - inaccessible).



Photograph 59: Lead-based light brown/blue paint on double doors in Room 125 (**Sample P1**).



Photograph 60: Lead-based brown paint on door and window frames in Room 125 (**Sample P2**).



Photograph 61: Lead-based white paint on walls in Room 125 (**Sample P3**).



Photograph 62: Lead-based green paint on door frame in Room 127 (**Sample P4**).



Photograph 63: Lead-based grey paint on a wall panel in Room 127 (**Sample P5**).



Photograph 64: Lead-based light brown / blue paint on door to Room 130 (**Sample P9**).



Photograph 65: Lead-based beige wall trim in Room 120 (**Sample P10**).



Photograph 66: Lead-based off-white trim paint in Room 106A above Room 143 (**Sample P12**).



Photograph 67: Lead-based white paint in Room 106A above Room 143 (**Sample P13**).



Photograph 68: Lead-based light blue/white paint on small door frame in Room 109 (**Sample P14**).



Photograph 69: Lead-based yellow paint on steel pipe on roof (**Sample P17**).



Photograph 70: Lead-based grey paint on wall of raised portion of roof (**Sample P18**) and lead-based white paint on soffit of raised portion of roof (**Sample P19**).



Photograph 71: Lead-based black paint on ladder to raised portion of roof (**Sample P20**).



Photograph 72: Lead-based dark brown paint on window trim on east side of raised portion of roof (**Sample P21**).



Photograph 73: Lead-based white paint on tar of foundation exterior (**Sample P22**).



Photograph 74: Lead-based blue paint on exterior of building (**Sample P24**).



Photograph 75: Lead-based dark brown paint on exterior door frame to Room 125 (**Sample P25**).



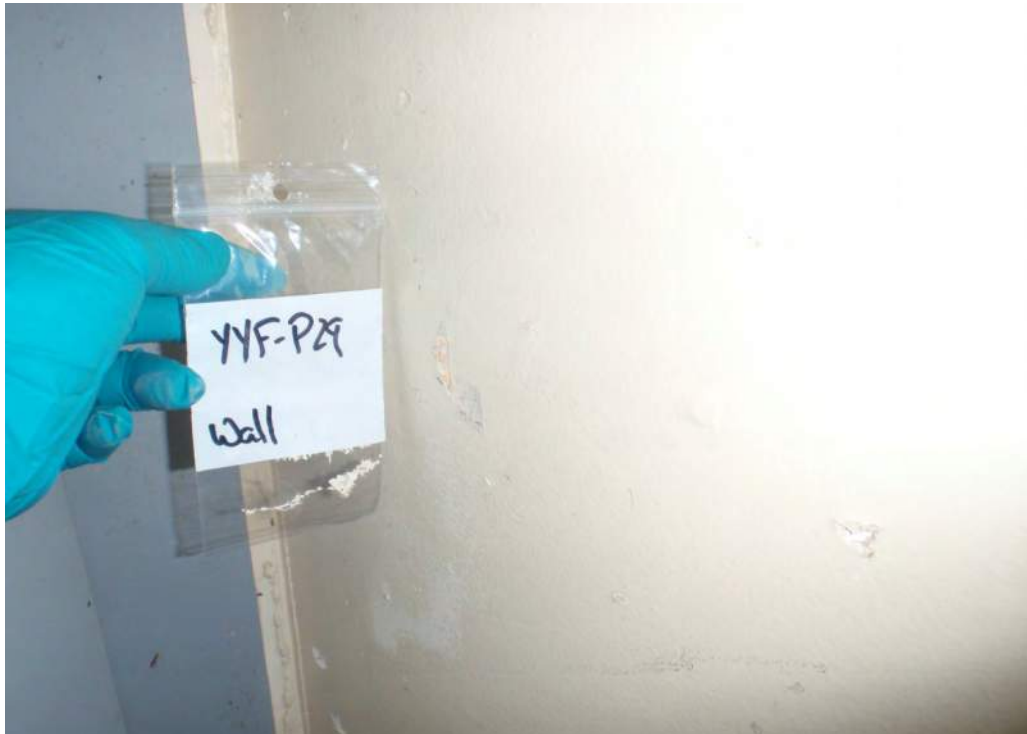
Photograph 76: Lead-based exterior light grey / white paint on concrete foundation (**Sample P26**).



Photograph 77: Lead-based pink wall and ceiling paint in Room 128B (**Sample P27**).



Photograph 78: Lead-based grey floor paint on concrete in Room 138 (**Sample P28**).



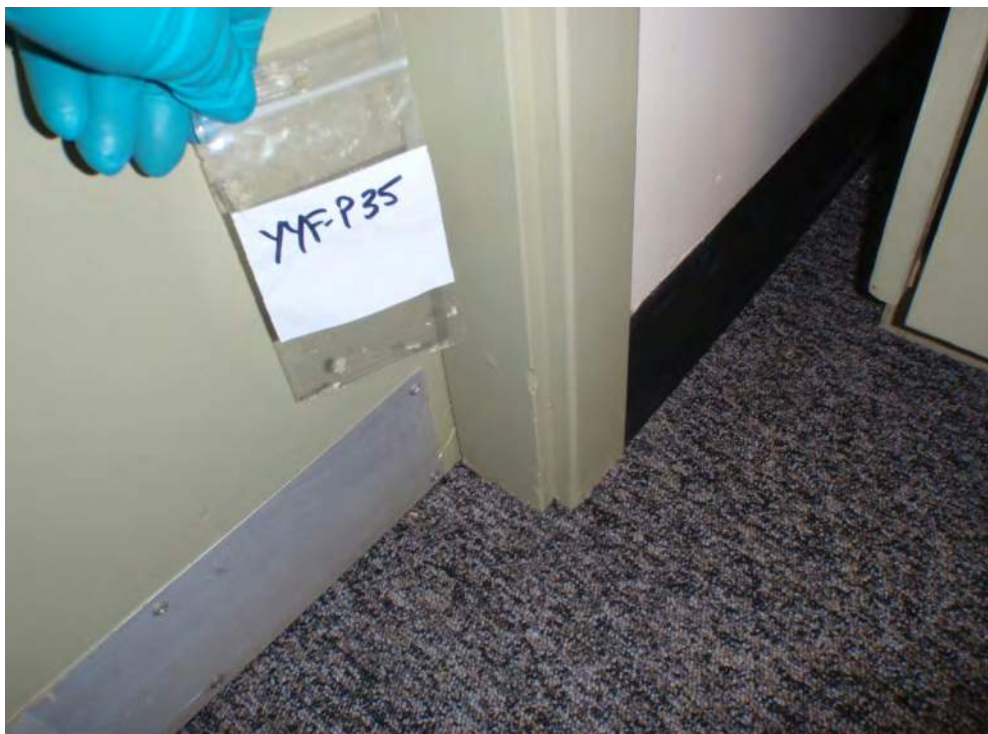
Photograph 79: Lead-based beige paint on walls of Room 138 (**Sample P29**).



Photograph 80: Lead-based beige paint on walls of Room 137 (**Sample P33**).



Photograph 81: Lead-based grey primer paint on wall in ceiling space of Room 142 (**Sample P34**).



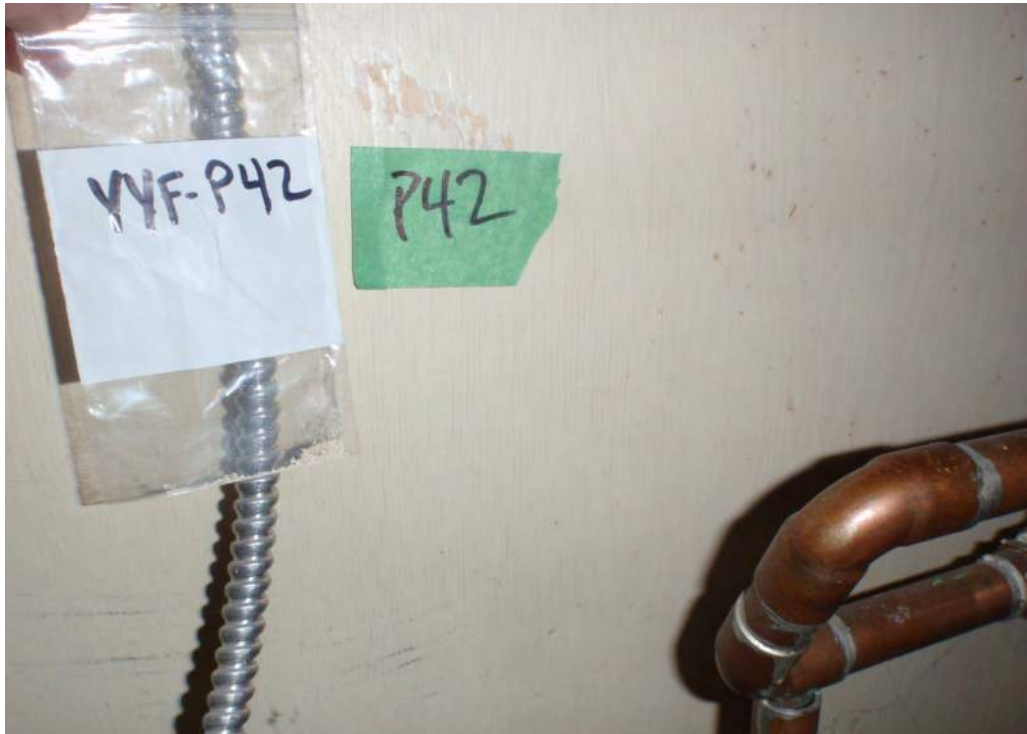
Photograph 82: Lead-based green paint on door frame of Room 135 (**Sample P35**).



Photograph 83: Lead-based red paint on window trim along the west wall of Room 106B (**Sample P40**).



Photograph 84: Lead-based brown paint on door to Room 143 (**Sample P41**).



Photograph 85: Lead-based yellow paint in wall cabinet on south end of Room 106B (**Sample P42**).



Photograph 86: Lead-based yellow paint on door frame of Room 112 (**Sample P44**).



Photograph 87: Lead-based beige paint on steel pipe near ceiling of Room 107 (**Sample P46**).

APPENDIX III

Laboratory Analytical Report (IATL)

Cover Letter

Apr 07, 2016

SNC - Lavalin, Inc.

Thank you for choosing iATL for your analytical needs. The Report herein along with the chain of custody contains details of (1) the transmittal of the samples from you to our laboratory, (2) the acceptance and analysis of the samples, (3) the supporting documentation tied to this project, (4) any QA notifications or communications, and (5) our invoice for this project. In addition:

- Please carefully look over these report deliverables and make sure that it meets your needs. Depending upon regulator and accrediting body limitations, you may have some choices for the formatting and data presentation beyond what follows. Please contact our customer service department for information on any options.
- You may intend for all, or select, samples in this submittal to move forward in the laboratory for other testing procedures. The batch sheet in this Report may list that authorization to proceed. Please login to our secure client portal and check this status or to confirm any additional analyses.
- If there are other offices, individuals, or customers who you think should receive this report – please send us that information and we will happily forward the report.


iATL is always seeking to improve our services and the customer experience. Any feedback that you can supply would benefit our commitment to quality. Please consider emailing any of the contacts on the next page of this report.

Finally, I wanted to take this opportunity to express our appreciation in your choice of iATL. We value our customers and seek to earn your business... one sample at a time.

Regards,



Eric Snyder
President, iATL



Frank Ehrenfeld
Laboratory
Director, iATL

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896891	Description: Grey Cementitious	Location:
Client No.: YYF-A1	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	5 Cellulose	95

Lab No.: 5896892	Description: Black Cove Base	Location:
Client No.: YYF-A2	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100


Lab No.: 5896893	Description: Off-White Joint Compound	Location:
Client No.: YYF-A3	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>PC 1.1 Chrysotile</i>	None Detected	98.9

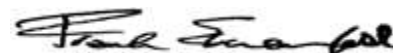
Lab No.: 5896893(L2)	Description: Tan Mastic	Location:
Client No.: YYF-A3	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100

Lab No.: 5896894	Description: Light Grey Floor Tile	Location:
Client No.: YYF-A4	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>PC 0.75 Chrysotile</i>	None Detected	99.25

Lab No.: 5896894(L2)	Description: Black Mastic	Location:
Client No.: YYF-A4	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
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Signature: 
Analyst: Tom Barkley

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

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PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896894(L3)
Client No.: YYF-A4

Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896895
Client No.: YYF-A5

Percent Asbestos:
PC 1.3 Chrysotile

Description: Tan Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
98.7

Lab No.: 5896896
Client No.: YYF-A6

Percent Asbestos:
None Detected

Description: Grey Putty
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896897
Client No.: YYF-A7

Percent Asbestos:
None Detected

Description: White Grey Ceiling Tile
Facility:

Percent Non-Asbestos Fibrous Material:
50 Cellulose
10 Fibrous Glass

Location:

Percent Non-Fibrous Material:
40

Lab No.: 5896898
Client No.: YYF-A8

Percent Asbestos:
None Detected

Description: Brown Tar Paper
Facility:

Percent Non-Asbestos Fibrous Material:
75 Cellulose

Location:

Percent Non-Fibrous Material:
25

Lab No.: 5896898(L2)
Client No.: YYF-A8

Percent Asbestos:
None Detected


Description: Tan Insulation
Facility:

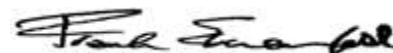
Percent Non-Asbestos Fibrous Material:
100 Fibrous Glass

Location:

Percent Non-Fibrous Material:
None Detected

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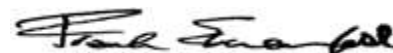
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

<p>Lab No.: 5896899 Client No.: YYF-A9</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Silver Insulation Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 15 Cellulose 15 Fibrous Glass</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 70</p>
<p>Lab No.: 5896899(L2) Client No.: YYF-A9</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Tar Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896900 Client No.: YYF-A10</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Cementitious Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896901 Client No.: YYF-A11</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Silver Insulation Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 15 Cellulose 15 Fibrous Glass</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 70</p>
<p>Lab No.: 5896901(L2) Client No.: YYF-A11</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Tar Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896902 Client No.: YYF-A12</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Grey Mortar Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>

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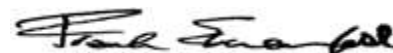
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

<p>Lab No.: 5896903 Client No.: YYF-A13</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Grey Ceiling Tile Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 50 Cellulose 20 Fibrous Glass</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 30</p>
<p>Lab No.: 5896904 Client No.: YYF-A14</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Grey Putty Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 2 Fibrous Glass</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 98</p>
<p>Lab No.: 5896905 Client No.: YYF-A15</p> <p><u>Percent Asbestos:</u> <i>10 Chrysotile</i></p>	<p>Description: Green Floor Tile Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 90</p>
<p>Lab No.: 5896905(L2) Client No.: YYF-A15</p> <p><u>Percent Asbestos:</u> <i>PC 2.5 Chrysotile</i></p>	<p>Description: Black Mastic Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 97.5</p>
<p>Lab No.: 5896906 Client No.: YYF-A16</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Cove Base Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896906(L2) Client No.: YYF-A16</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Brown Mastic Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Laboratory Director

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Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896907
Client No.: YYF-A17

Percent Asbestos:
None Detected

Description: Black Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896907(L2)
Client No.: YYF-A17

Percent Asbestos:
None Detected

Description: White Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896908
Client No.: YYF-A18

Percent Asbestos:
None Detected

Description: Red Caulk
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896909
Client No.: YYF-A19

Percent Asbestos:
None Detected

Description: White Caulk
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896910
Client No.: YYF-A20

Percent Asbestos:
15 Chrysotile
10 Crocidolite

Description: Grey Transite
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
75

Lab No.: 5896911
Client No.: YYF-A21

Percent Asbestos:
PC 5.1 Amosite

Description: Tan Insulation
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
94.9

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Analyst: Tom Barkley

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

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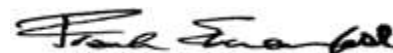
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896912 Client No.: YYF-A22 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Grey Cementitious Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896913 Client No.: YYF-A23 <u>Percent Asbestos:</u> <i>40 Chrysotile</i>	Description: Grey Gasket Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 60
Lab No.: 5896914 Client No.: YYF-A24 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Black Tar Paper Facility: <u>Percent Non-Asbestos Fibrous Material:</u> 75 Cellulose	Location: <u>Percent Non-Fibrous Material:</u> 25
Lab No.: 5896915 Client No.: YYF-A25 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896916 Client No.: YYF-A26 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896917 Client No.: YYF-A27 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Tan Ceiling Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> 95 Cellulose	Location: <u>Percent Non-Fibrous Material:</u> 5

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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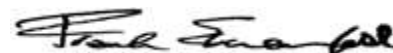
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

<p>Lab No.: 5896918 Client No.: YYF-A28</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Cove Base Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896918(L2) Client No.: YYF-A28</p> <p><u>Percent Asbestos:</u> <i>PC 1.1 Chrysotile</i></p>	<p>Description: Off-White Joint Compound Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 98.9</p>
<p>Lab No.: 5896918(L3) Client No.: YYF-A28</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Mastic Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896919 Client No.: YYF-A29</p> <p><u>Percent Asbestos:</u> <i>PC 0.5 Chrysotile</i></p>	<p>Description: Grey Sealant Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 5 Synthetic</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 94.5</p>
<p>Lab No.: 5896920 Client No.: YYF-A30</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Joint Compound Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896921 Client No.: YYF-A31</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Grey Ceiling Tile Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 25 Cellulose 25 Fibrous Glass</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 50</p>

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PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896922	Description: White Brown Ceiling Tile	Location:
Client No.: YYF-A32	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 90 Cellulose	<u>Percent Non-Fibrous Material:</u> 10

Lab No.: 5896923	Description: Tan Mastic	Location:
Client No.: YYF-A33	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5896924	Description: Grey Floor Tile	Location:
Client No.: YYF-A34	Facility:	
<u>Percent Asbestos:</u> <i>PC 8.7 Chrysotile</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 91.3

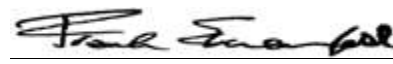
Lab No.: 5896924(L2)	Description: Black Mastic	Location:
Client No.: YYF-A34	Facility:	
<u>Percent Asbestos:</u> <i>PC 0.5 Chrysotile</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 99.5

Lab No.: 5896925	Description: Black Mastic	Location:
Client No.: YYF-A35	Facility:	
<u>Percent Asbestos:</u> <i>PC 0.5 Chrysotile</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 99.5

Lab No.: 5896925(L2)	Description: White Leveling Compound	Location:
Client No.: YYF-A35	Facility:	
<u>Percent Asbestos:</u> <i>PC 1.3 Chrysotile</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 98.7

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PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896926
Client No.: YYF-A36

Percent Asbestos:
None Detected

Description: White Caulk
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896927
Client No.: YYF-A37

Percent Asbestos:
None Detected

Description: White Brown Ceiling Tile
Facility:
Percent Non-Asbestos Fibrous Material:
50 Fibrous Glass
20 Cellulose

Location:

Percent Non-Fibrous Material:
30

Lab No.: 5896928
Client No.: YYF-A38

Percent Asbestos:
PC 6.0 Chrysotile

Description: Brown Floor Tile
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
94

Lab No.: 5896929
Client No.: YYF-A39

Percent Asbestos:
None Detected

Description: Grey Woven Material
Facility:
Percent Non-Asbestos Fibrous Material:
40 Cellulose

Location:

Percent Non-Fibrous Material:
60

Lab No.: 5896930
Client No.: YYF-A40

Percent Asbestos:
PC 1.2 Chrysotile

Description: Off-White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
98.8

Lab No.: 5896931
Client No.: YYF-A41

Percent Asbestos:
PC 1.2 Chrysotile

Description: Off-White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
98.8

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PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896932
Client No.: YYF-A42

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896933
Client No.: YYF-A43

Percent Asbestos:
PC 3.5 Chrysotile

Description: Grey Putty
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
96.5

Lab No.: 5896934
Client No.: YYF-A44

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896935
Client No.: YYF-A45

Percent Asbestos:
PC 7.2 Chrysotile

Description: Grey Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
92.8

Lab No.: 5896935(L2)
Client No.: YYF-A45

Percent Asbestos:
PC Trace Chrysotile

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5896936
Client No.: YYF-A46

Percent Asbestos:
None Detected

Description: Grey Cementitious
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 6:14:59 AM

Signature: 

Analyst: Tom Barkley

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896937
Client No.: YYF-A47
Percent Asbestos:
PC 0.75 Chrysotile

Description: Off-White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected


Location:
Percent Non-Fibrous Material:
99.25

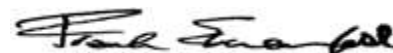
Lab No.: 5896938
Client No.: YYF-A48
Percent Asbestos:
None Detected

Description: Grey Grout
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 6:14:59 AM
Signature: 
Analyst: Tom Barkley

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

<p>Lab No.: 5896939 Client No.: YYF-A49</p> <p><u>Percent Asbestos:</u> <i>PC 4.1 Chrysotile</i></p>	<p>Description: Grey Putty Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 95.9</p>
<p>Lab No.: 5896940 Client No.: YYF-A50</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Wrap Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 60 Cellulose 30 Mineral Wool</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 10</p>
<p>Lab No.: 5896941 Client No.: YYF-A51</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White/Grey Ceiling Tile Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 40 Cellulose 30 Mineral Wool</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 30</p>
<p>Lab No.: 5896942 Client No.: YYF-A52</p> <p><u>Percent Asbestos:</u> <i>PC 2.4 Chrysotile</i></p>	<p>Description: Grey Joint Compound Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 97.6</p>
<p>Lab No.: 5896943 Client No.: YYF-A53</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: White Joint Compound Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896944 Client No.: YYF-A54</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Grey Grout Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896945	Description: Brown Rubber	Location:
Client No.: YYF-A55	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896946	Description: Brown Mastic	Location:
Client No.: YYF-A56	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5896946(L2)	Description: White Joint Compound	Location:
Client No.: YYF-A56	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

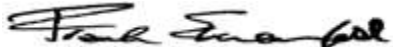
Lab No.: 5896947	Description: Off-White Mastic	Location:
Client No.: YYF-A57	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896948	Description: Tan Mastic	Location:
Client No.: YYF-A58	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896949	Description: White Joint Compound	Location:
Client No.: YYF-A59	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896950 Client No.: YYF-A60	Description: Brown Wallpaper Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 30 Cellulose	<u>Percent Non-Fibrous Material:</u> 70
Lab No.: 5896951 Client No.: YYF-A61	Description: Grey Rubber Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896952 Client No.: YYF-A62	Description: Yellow Mastic Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896953 Client No.: YYF-A63	Description: Black Grout Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896954 Client No.: YYF-A64	Description: Off-White Mastic Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896955 Client No.: YYF-A65	Description: White Non-Fibrous Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

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Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
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Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896956 Client No.: YYF-A66 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Grey Mastic Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896957 Client No.: YYF-A67 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Grey Caulk Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896958 Client No.: YYF-A68 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Brown Ceiling Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> 98 Cellulose	Location: <u>Percent Non-Fibrous Material:</u> 2
Lab No.: 5896959 Client No.: YYF-A69 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896960 Client No.: YYF-A70 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5896961 Client No.: YYF-A71 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Texture/Plaster Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Vane Smith

Approved By: 
 Frank E. Ehrenfeld, III
 Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896962 Client No.: YYF-A72	Description: White/Grey Ceiling Tile Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 60 Cellulose 10 Mineral Wool	<u>Percent Non-Fibrous Material:</u> 30

Lab No.: 5896963 Client No.: YYF-A73	Description: White/Grey Ceiling Tile Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 40 Cellulose 30 Mineral Wool	<u>Percent Non-Fibrous Material:</u> 30


Lab No.: 5896964 Client No.: YYF-A74	Description: White/Grey Ceiling Tile Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 40 Cellulose 20 Mineral Wool	<u>Percent Non-Fibrous Material:</u> 40


Lab No.: 5896965 Client No.: YYF-A75	Description: Orange Mastic Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896966 Client No.: YYF-A76	Description: Tan Rubber Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896967 Client No.: YYF-A77	Description: White Texture Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896968 Client No.: YYF-A78	Description: White Texture Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896969 Client No.: YYF-A79	Description: White Texture Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5896969(L2) Client No.: YYF-A79	Description: White Joint Compound Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5896970 Client No.: YYF-A80	Description: White Texture Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896971 Client No.: YYF-A81	Description: White Texture Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896972 Client No.: YYF-A82	Description: White Joint Compound Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896973
Client No.: YYF-A83

Percent Asbestos:
None Detected

Description: White/Black Shingle
Facility:

Percent Non-Asbestos Fibrous Material:
15 Synthetic

Location:

Percent Non-Fibrous Material:
85

Lab No.: 5896974
Client No.: YYF-A84

Percent Asbestos:
None Detected

Description: White/Blace Shingle
Facility:

Percent Non-Asbestos Fibrous Material:
15 Synthetic

Location:

Percent Non-Fibrous Material:
85

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature:
Analyst: Vane Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896975	Description: Black Mastic	Location:
Client No.: YYF-A85	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose	<u>Percent Non-Fibrous Material:</u> 95

Lab No.: 5896976	Description: Black Mastic	Location:
Client No.: YYF-A86	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose	<u>Percent Non-Fibrous Material:</u> 95


Lab No.: 5896977	Description: Black Mastic	Location:
Client No.: YYF-A87	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose	<u>Percent Non-Fibrous Material:</u> 95

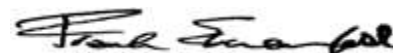
Lab No.: 5896978	Description: Black/White Shingle	Location:
Client No.: YYF-A88	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 15 Synthetic	<u>Percent Non-Fibrous Material:</u> 85

Lab No.: 5896978(L2)	Description: Black Roof Material	Location:
Client No.: YYF-A88	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 25 Cellulose Trace Fibrous Glass	<u>Percent Non-Fibrous Material:</u> 75

Lab No.: 5896979	Description: Grey Caulk	Location:
Client No.: YYF-A89	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rachel McQuiggan

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

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8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896980 Client No.: YYF-A90	Description: Black Shingle Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 20 Synthetic	<u>Percent Non-Fibrous Material:</u> 80

Lab No.: 5896981 Client No.: YYF-A91	Description: Black/Grey Caulk Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose	<u>Percent Non-Fibrous Material:</u> 95


Lab No.: 5896982 Client No.: YYF-A92	Description: Black Mastic Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> Trace Fibrous Glass	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5896983 Client No.: YYF-A93	Description: Grey Cementitious Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896984 Client No.: YYF-A94	Description: Black Mastic Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> Trace Fibrous Glass	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5896985 Client No.: YYF-A95	Description: Grey Caulk Facility:	Location:
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rachel McQuiggan

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
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Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896985(L2)
Client No.: YYF-A95

Description: Clear Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896986
Client No.: YYF-A96

Description: Black/Grey Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896987
Client No.: YYF-A97

Description: Dk.Brown Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896988
Client No.: YYF-A98

Description: White Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896989
Client No.: YYF-A99

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896990
Client No.: YYF-A100

Description: Brown Paper
Facility:


Location:


Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
95 Cellulose

Percent Non-Fibrous Material:
5

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rachel McQuiggan

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
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Report Date: 4/7/2016
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Client: SNC483

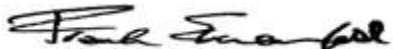
PLM BULK SAMPLE ANALYSIS SUMMARY

<p>Lab No.: 5896991 Client No.: YYF-A101</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Tan Mastic Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>
<p>Lab No.: 5896992 Client No.: YYF-A102</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Grey Caulk Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 95</p>
<p>Lab No.: 5896993 Client No.: YYF-A103</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Tar Paper Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 70 Cellulose</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 30</p>
<p>Lab No.: 5896994 Client No.: YYF-A104</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black/Grey Shingle Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 15 Synthetic</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 85</p>
<p>Lab No.: 5896994(L2) Client No.: YYF-A104</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Roof Material Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> 20 Cellulose 5 Fibrous Glass</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 75</p>
<p>Lab No.: 5896994(L3) Client No.: YYF-A104</p> <p><u>Percent Asbestos:</u> <i>None Detected</i></p>	<p>Description: Black Tar Facility:</p> <p><u>Percent Non-Asbestos Fibrous Material:</u> None Detected</p>	<p>Location:</p> <p><u>Percent Non-Fibrous Material:</u> 100</p>

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM

Signature: 
Analyst: Rachel McQuiggan

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896994(L4)
Client No.: YYF-A104

Description: Brown Fibrous
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Percent Non-Fibrous Material:
10

Lab No.: 5896995
Client No.: YYF-A105

Description: Grey Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896996
Client No.: YYF-A106

Description: Brown Tar Paper
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Percent Non-Fibrous Material:
10

Lab No.: 5896997
Client No.: YYF-A107

Description: Black Tar
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896998
Client No.: YYF-A108

Description: White Texture
Facility:

Location:

Percent Asbestos:
PC 4.1 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95.9

Lab No.: 5896999
Client No.: YYF-A109

Description: White Texture
Facility:


Location:

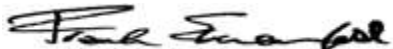
Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
99 Fibrous Glass

Percent Non-Fibrous Material:
1

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896999(L2)
Client No.: YYF-A109

Description: Black Tar
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897000
Client No.: YYF-A110

Description: White Texture
Facility:

Location:

Percent Asbestos:
PC 4.7 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95.3

Lab No.: 5897001
Client No.: YYF-A111

Description: Grey/White Paint
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897002
Client No.: YYF-A112

Description: Grey Paper
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Percent Non-Fibrous Material:
10

Lab No.: 5897003
Client No.: YYF-A113

Description: White Putty
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897004
Client No.: YYF-A114

Description: White Texture
Facility:


Location:

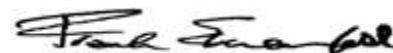
Percent Asbestos:
PC 5.0 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897005
Client No.: YYF-A115

Percent Asbestos:
None Detected

Description: White Texture
Facility:

Percent Non-Asbestos Fibrous Material:
3 Other

Location:

Percent Non-Fibrous Material:
97

Lab No.: 5897006
Client No.: YYF-A116

Percent Asbestos:
PC 4.8 Chrysotile

Description: White Texture
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
95.2

Lab No.: 5897007
Client No.: YYF-A117

Percent Asbestos:
None Detected

Description: Grey Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897008
Client No.: YYF-A118

Percent Asbestos:
None Detected

Description: Yellow Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897009
Client No.: YYF-A119

Percent Asbestos:
None Detected

Description: Brown Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897010
Client No.: YYF-A120

Percent Asbestos:
None Detected

Description: Grey/Black Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

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Signature: 

Analyst: Rachel McQuiggan

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

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8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897010(L2)
Client No.: YYF-A120

Description: Tan/Grey Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

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Signature: 

Analyst: Rachel McQuiggan

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

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Burnaby BC V5A 4N6

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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897011
Client No.: YYF-A121

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5897012
Client No.: YYF-A122

Description: Orange Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897013
Client No.: YYF-A123

Description: Orange Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897013(L2)
Client No.: YYF-A123

Description: Off-White Foam
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897014
Client No.: YYF-A124

Description: Yellow Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897015
Client No.: YYF-A125

Description: White Joint Compound
Facility:


Location:


Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rodney Redman

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

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8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897016	Description: Grey Cementitious	Location:
Client No.: YYF-A126	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 5 Fibrous Glass	<u>Percent Non-Fibrous Material:</u> 95

Lab No.: 5897017	Description: Yellow/Grey Mastic	Location:
Client No.: YYF-A127	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5897018	Description: Orange Non-Fibrous	Location:
Client No.: YYF-A128	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100


Lab No.: 5897019	Description: Tan/Silver Wrap	Location:
Client No.: YYF-A129	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 10 Fibrous Glass 60 Cellulose	<u>Percent Non-Fibrous Material:</u> 40

Lab No.: 5897020	Description: Grey Gasket	Location:
Client No.: YYF-A130	Facility:	
<u>Percent Asbestos:</u> <i>15 Chrysotile</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 15 Cellulose	<u>Percent Non-Fibrous Material:</u> 70

Lab No.: 5897021	Description: White/Silver/Tan Wrap	Location:
Client No.: YYF-A131	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 10 Fibrous Glass 60 Cellulose	<u>Percent Non-Fibrous Material:</u> 40

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rodney Redman

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897022
Client No.: YYF-A132

Percent Asbestos:
None Detected

Description: Black Non-Fibrous
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897023
Client No.: YYF-A133

Percent Asbestos:
None Detected

Description: Black Gasket
Facility:

Percent Non-Asbestos Fibrous Material:
10 Cellulose

Location:

Percent Non-Fibrous Material:
90

Lab No.: 5897024
Client No.: YYF-A134

Percent Asbestos:
None Detected

Description: Off-White Wrap
Facility:

Percent Non-Asbestos Fibrous Material:
20 Mineral Wool
60 Cellulose

Location:

Percent Non-Fibrous Material:
20

Lab No.: 5897025
Client No.: YYF-A135

Percent Asbestos:
PC 4.8 Chrysotile

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
95.2

Lab No.: 5897025(L2)
Client No.: YYF-A135

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897026
Client No.: YYF-A136

Percent Asbestos:
None Detected


Description: Grey Caulk
Facility:


Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Signature: 
Analyst: Rodney Redman

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897027
Client No.: YYF-A137
Percent Asbestos:
None Detected

Description: Brown Rubber
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897027(L2)
Client No.: YYF-A137
Percent Asbestos:
None Detected

Description: Clear Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897028
Client No.: YYF-A138
Percent Asbestos:
None Detected

Description: White/Tan Ceiling Tile
Facility:
Percent Non-Asbestos Fibrous Material:
Cellulose
90

Location:
Percent Non-Fibrous Material:
10

Lab No.: 5897029
Client No.: YYF-A139
Percent Asbestos:
None Detected

Description: White/Tan Ceiling Tile
Facility:
Percent Non-Asbestos Fibrous Material:
Cellulose
90

Location:
Percent Non-Fibrous Material:
10

Lab No.: 5897030
Client No.: YYF-A140
Percent Asbestos:
None Detected

Description: Grey Cementitious
Facility:
Percent Non-Asbestos Fibrous Material:
Fibrous Glass
10


Location:
Percent Non-Fibrous Material:
90


Lab No.: 5897031
Client No.: YYF-A141
Percent Asbestos:
None Detected

Description: Black Floor Tile
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

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8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897031(L2)
Client No.: YYF-A141

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897032
Client No.: YYF-A142

Description: Blue Floor Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897032(L2)
Client No.: YYF-A142

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5897033
Client No.: YYF-A143

Description: Tan/Blue/Pink Wrap
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
10 Mineral Wool
50 Cellulose

Percent Non-Fibrous Material:
40

Lab No.: 5897034
Client No.: YYF-A144

Description: Black Wrap
Facility:


Location:


Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
15 Fibrous Glass

Percent Non-Fibrous Material:
85

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
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Signature: 
Analyst: Rodney Redman

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897035
Client No.: YYF-A145

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
1 Cellulose

Location:

Percent Non-Fibrous Material:
99

Lab No.: 5897035(L2)
Client No.: YYF-A145

Percent Asbestos:
None Detected

Description: Tan/Yellow Insulation
Facility:

Percent Non-Asbestos Fibrous Material:
10 Fibrous Glass
85 Cellulose

Location:

Percent Non-Fibrous Material:
5

Lab No.: 5897036
Client No.: YYF-A146

Percent Asbestos:
PC 1.2 Chrysotile

Description: Red Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
98.8

Lab No.: 5897037
Client No.: YYF-A147

Percent Asbestos:
None Detected

Description: Grey Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897038
Client No.: YYF-A148

Percent Asbestos:
None Detected

Description: Lt. Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897039
Client No.: YYF-A149

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature: 

Analyst: Ellen Smith

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897040
Client No.: YYF-A150

Percent Asbestos:
None Detected

Description: Tan Ceiling Tile
Facility:

Percent Non-Asbestos Fibrous Material:
35 Cellulose
20 Fibrous Glass

Location:

Percent Non-Fibrous Material:
45

Lab No.: 5897041
Client No.: YYF-A151

Percent Asbestos:
None Detected

Description: Tan Ceiling Tile
Facility:

Percent Non-Asbestos Fibrous Material:
35 Cellulose
20 Fibrous Glass

Location:

Percent Non-Fibrous Material:
45

Lab No.: 5897042
Client No.: YYF-A152

Percent Asbestos:
None Detected

Description: Green Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897042(L2)
Client No.: YYF-A152

Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897043
Client No.: YYF-A153

Percent Asbestos:
None Detected

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897043(L2)
Client No.: YYF-A153

Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature: 

Analyst: Ellen Smith

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

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Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897044
Client No.: YYF-A154
Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897045
Client No.: YYF-A155
Percent Asbestos:
None Detected

Description: Lt.Blue Floor Tile
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897045(L2)
Client No.: YYF-A155
Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected


Location:
Percent Non-Fibrous Material:
100

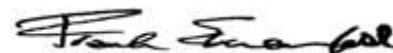
Lab No.: 5897046
Client No.: YYF-A156
Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Ellen Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897047
Client No.: YYF-A157

Percent Asbestos:
None Detected

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897047(L2)
Client No.: YYF-A157

Percent Asbestos:
None Detected

Description: Black/Brown Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897048
Client No.: YYF-A158

Percent Asbestos:
None Detected

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897048(L2)
Client No.: YYF-A158

Percent Asbestos:
None Detected

Description: Grey Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897049
Client No.: YYF-A159

Percent Asbestos:
None Detected

Description: Blue Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897050
Client No.: YYF-A160

Percent Asbestos:
None Detected


Description: Yellow Mastic
Facility:


Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

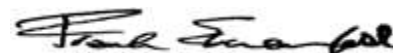
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897051 Client No.: YYF-A161 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Black Mastic Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5897052 Client No.: YYF-A162 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5897053 Client No.: YYF-A163 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5897054 Client No.: YYF-A164 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Off-White Vinyl Sheet Flooring Facility: <u>Percent Non-Asbestos Fibrous Material:</u> 20 Cellulose 10 Fibrous Glass	Location: <u>Percent Non-Fibrous Material:</u> 70
Lab No.: 5897054(L2) Client No.: YYF-A164 <u>Percent Asbestos:</u> <i>None Detected</i>	Description: Tan Mastic Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 100
Lab No.: 5897055 Client No.: YYF-A165 <u>Percent Asbestos:</u> <i>PC 1.5 Chrysotile</i>	Description: Off-White Floor Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected	Location: <u>Percent Non-Fibrous Material:</u> 98.5

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
 Frank E. Ehrenfeld, III
 Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897055(L2)
Client No.: YYF-A165

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897055(L3)
Client No.: YYF-A165

Percent Asbestos:
None Detected

Description: Grey Cementitious
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897056
Client No.: YYF-A166

Percent Asbestos:
None Detected

Description: Blue Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897056(L2)
Client No.: YYF-A166

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897056(L3)
Client No.: YYF-A166

Percent Asbestos:
None Detected

Description: Clear Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897057
Client No.: YYF-A167

Percent Asbestos:
None Detected


Description: White Wrap
Facility:


Percent Non-Asbestos Fibrous Material:
90 Cellulose

Location:

Percent Non-Fibrous Material:
10

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897058
Client No.: YYF-A168

Description: Grey Caulk
Facility:

Location:

Percent Asbestos:
10 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
90

Lab No.: 5897059
Client No.: YYF-A169

Description: Black/White Non-Fibrous
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897060
Client No.: YYF-A170

Description: Tan Floor Tile
Facility:

Location:

Percent Asbestos:
PC 1.4 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
98.6

Lab No.: 5897060(L2)
Client No.: YYF-A170

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897060(L3)
Client No.: YYF-A170

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897061
Client No.: YYF-A171

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Approved By: 

Date Analyzed: 4/6/2016 12:00:00 AM

Frank E. Ehrenfeld, III

Signature: 

Laboratory Director

Analyst: Shane Cone

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897062	Description: Off-White Ceiling Tile	Location:
Client No.: YYF-A172	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 50 Cellulose 20 Fibrous Glass	<u>Percent Non-Fibrous Material:</u> 30

Lab No.: 5897063	Description: Off-White Caulk	Location:
Client No.: YYF-A173	Facility:	
<u>Percent Asbestos:</u> <i>PC 1.4 Chrysotile</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 98.6


Lab No.: 5897064	Description: Grey Cementitious	Location:
Client No.: YYF-A174	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

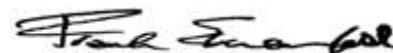
Lab No.: 5897065	Description: White Caulk	Location:
Client No.: YYF-A175	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Lab No.: 5897066	Description: Tan Insulation	Location:
Client No.: YYF-A176	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> 90 Fibrous Glass	<u>Percent Non-Fibrous Material:</u> 10

Lab No.: 5897067	Description: Black Rubber Tile	Location:
Client No.: YYF-A177	Facility:	
<u>Percent Asbestos:</u> <i>None Detected</i>	<u>Percent Non-Asbestos Fibrous Material:</u> None Detected	<u>Percent Non-Fibrous Material:</u> 100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897068
Client No.: YYF-A178
Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897069
Client No.: YYF-A179
Percent Asbestos:
None Detected

Description: Grey Cementitious
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897070
Client No.: YYF-A180
Percent Asbestos:
PC 1.2 Chrysotile

Description: Off-White Floor Tile
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected


Location:
Percent Non-Fibrous Material:
98.8

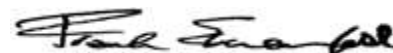
Lab No.: 5897070(L2)
Client No.: YYF-A180
Percent Asbestos:
None Detected

Description: Black Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897071	Description: White Joint Compound	Location:
Client No.: YYF-A181	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100

Lab No.: 5897072	Description: White Mortar	Location:
Client No.: YYF-A182	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100


Lab No.: 5897073	Description: Grey Grout	Location:
Client No.: YYF-A183	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100


Lab No.: 5897074	Description: Grey Mastic	Location:
Client No.: YYF-A184	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100

Lab No.: 5897075	Description: White Joint Compound	Location:
Client No.: YYF-A185	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100

Lab No.: 5897076	Description: White Joint Compound	Location:
Client No.: YYF-A186	Facility:	
<u>Percent Asbestos:</u>	<u>Percent Non-Asbestos Fibrous Material:</u>	<u>Percent Non-Fibrous Material:</u>
<i>None Detected</i>	None Detected	100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Randy Caran

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897077
Client No.: YYF-A187

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897078
Client No.: YYF-A188

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897079
Client No.: YYF-A189

Percent Asbestos:
None Detected

Description: Grey Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897079(L2)
Client No.: YYF-A189

Percent Asbestos:
None Detected

Description: White Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897080
Client No.: YYF-A190

Percent Asbestos:
None Detected

Description: Grey Vinyl Sheet Flooring
Facility:

Percent Non-Asbestos Fibrous Material:
10 Synthetic

Location:

Percent Non-Fibrous Material:
90

Lab No.: 5897081
Client No.: YYF-A191

Percent Asbestos:
None Detected

Description: Grey Grout
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature: 

Analyst: Randy Caran

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897082
Client No.: YYF-A192

Description: White Grout
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897083
Client No.: YYF-A193

Description: Grey Vinyl Sheet Flooring
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
10 Cellulose
10 Synthetic

Percent Non-Fibrous Material:
80

Lab No.: 5897084
Client No.: YYF-A194

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897085
Client No.: YYF-A195

Description: Grey Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897086
Client No.: YYF-A196

Description: Grey Floor Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897086(L2)
Client No.: YYF-A196

Description: Yellow Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Approved By: 

Date Analyzed: 4/6/2016 12:00:00 AM

Frank E. Ehrenfeld, III

Signature: 

Laboratory Director

Analyst: Randy Caran

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897086(L3)
Client No.: YYF-A196

Percent Asbestos:
PC 3.6 Chrysotile

Description: White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
96.4

Lab No.: 5897086(L4)
Client No.: YYF-A196

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897086(L5)
Client No.: YYF-A196

Percent Asbestos:
None Detected

Description: White Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897087
Client No.: YYF-A197

Percent Asbestos:
None Detected

Description: Off-White Vinyl Sheet Flooring
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897088
Client No.: YYF-A198

Percent Asbestos:
None Detected

Description: Off-White Vinyl Sheet Flooring
Facility:

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Location:

Percent Non-Fibrous Material:
95

Lab No.: 5897088(L2)
Client No.: YYF-A198

Percent Asbestos:
None Detected


Description: Grey Floor Tile
Facility:


Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Randy Caran

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897088(L3)
Client No.: YYF-A198

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897089
Client No.: YYF-A199

Description: White/Brown Ceiling Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
98 Cellulose

Percent Non-Fibrous Material:
2

Lab No.: 5897090
Client No.: YYF-A200

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897090(L2)
Client No.: YYF-A200

Description: Grey Floor Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897090(L3)
Client No.: YYF-A200

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897091
Client No.: YYF-A201

Description: White/Brown Ceiling Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
100 Cellulose

Percent Non-Fibrous Material:
Trace

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Approved By: 

Date Analyzed: 4/6/2016 12:00:00 AM

Frank E. Ehrenfeld, III

Signature: 

Laboratory Director

Analyst: Randy Caran

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897092
Client No.: YYF-A202

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897092(L2)
Client No.: YYF-A202

Percent Asbestos:
PC 2.4 Chrysotile

Description: Black/Grey Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
97.6

Lab No.: 5897093
Client No.: YYF-A203

Percent Asbestos:
None Detected

Description: White Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897094
Client No.: YYF-A204

Percent Asbestos:
None Detected

Description: Tan Putty
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897095
Client No.: YYF-A205

Percent Asbestos:
None Detected

Description: Grey Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897096
Client No.: YYF-A206

Percent Asbestos:
None Detected

Description: Grey Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature: 

Analyst: Randy Caran

Approved By: 

Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897097
Client No.: YYF-A207
Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897098
Client No.: YYF-A208
Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Lab No.: 5897099
Client No.: YYF-A209
Percent Asbestos:
None Detected

Description: Red Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected


Location:
Percent Non-Fibrous Material:
100


Lab No.: 5897100
Client No.: YYF-A210
Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Randy Caran

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Client: SNC483

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Appendix to Analytical Report

Customer Contact: Tony Kavelares
Analysis: US EPA 600, R93-116

This appendix seeks to promote greater understanding of any observations, exceptions, special instructions, or circumstances that the laboratory needs to communicate to the client concerning the above samples. The information below is used to help promote your ability to make the most informed decisions for you and your customers. Please note the following points of contact for any questions you may have.

iATL Customer Service: customerservice@iatl.com

iATL Office Manager: cdavis@iatl.com

iATL Account Representative: Shirley Clark

Sample Login Notes: See Batch Sheet Attached

Sample Matrix: Bulk Building Materials

Exceptions Noted: See Following Pages

General Terms, Warrants, Limits, Qualifiers:

General information about iATL capabilities and client/laboratory relationships and responsibilities are spelled out in iATL policies that are listed at www.iATL.com and in our Quality Assurance Manual per ISO 17025 standard requirements. The information therein is a representation of iATL definitions and policies for turnaround times, sample submittal, collection media, blank definitions, quantification issues and limit of detection, analytical methods and procedures, sub-contracting policies, results reporting options, fees, terms, and discounts, confidentiality, sample archival and disposal, and data interpretation.

iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

This confidential report relates only to those item(s) tested and does not represent an endorsement by NIST-NVLAP, AIHA LAP LLC, or any agency of local, state or province governments nor of any agency of the U.S. government.

This report shall not be reproduced except in full, without written approval of the laboratory.

Information Pertinent to this Report:

Analysis by US EPA 600 93-116: Determination of Asbestos in Bulk Building Materials by Polarized Light Microscopy (PLM).

Certification:

- NIST-NVLAP No. 101165-0
- NY-DOH No. 11021
- AIHA-LAP, LLC No. 100188

Quantification at <0.25% by volume is possible with this method. (PC) Indicates Stratified Point Count Method performed. (PC-Trace) means that asbestos was detected but is not quantifiable under the Point Counting regimen. Analysis includes all distinct separable layers in accordance with EPA 600 Method. If not reported or otherwise noted, layer is either not present or the client has specifically requested that it not be analyzed (ex. analyze until positive instructions). Small asbestos fibers may be missed by PLM due to resolution limitations of the optical microscope. Therefore, PLM is not consistently reliable in detecting asbestos in non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing.

Analytical Methodology Alternatives: Your initial request for analysis may not have accounted for recent advances in regulatory requirements or advances in technology that are routinely used in similar situations for other qualified projects. You may have the option to explore additional analysis for further information. Below are a few options, listed as the matrix followed by the appropriate methodology. Also included are links to more information on our website.

Bulk Building Materials that are Non-Friable Organically Bound (NOB) by Gravimetric Reduction techniques employing PLM and TEM: ELAP 198.6 (PLM-NOB), ELAP 198.4 (TEM-NOB)

Loose Fill Vermiculite Insulation, Attic Insulation, Zonolite (copyright), etc.: US EPA 600 R-4/004 (multi-tiered analytical process)
Sprayed On Insulation/Fireproofing with Vermiculite (SOF-V): ELAP 198.8 (PLM-SOF-V)

Soil, sludge, sediment, aggregate, and like materials analyzed for asbestos or other elongated mineral particles (ex. erionite, etc.): ASTM D7521, CARB 435, and other options available

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Client: SNC483

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Asbestos in Surface Dust according to one of ASTM's Methods (very dependent on sampling collection technique – by TEM): ASTM D 5755, D5756, or D6480

Various other asbestos matrices (air, water, etc.) and analytical methods are available.

Disclaimers / Qualifiers:

There may be some samples in this project that have a "NOTE:" associated with a sample result. We use added disclaimers or qualifiers to inform the client about something that requires further explanation. Here is a list with highlighted disclaimers that may be pertinent to this project. For a full explanation of these and other disclaimers, please inquire at customerservice@iatl.com.

- 1) Note: No mastic provided for analysis.
- 2) Note: Insufficient mastic provided for analysis.
- 3) Note: Insufficient material provided for analysis.
- 4) Note: Insufficient sample provided for QC reanalysis.
- 5) Note: Different material than indicated on Sample Log / Description.
- 6) Note: Sample not submitted.
- 7) Note: Attached to asbestos containing material.
- 8) Note: Received wet.
- 9) Note: Possible surface contamination.
- 10) Note: Not building material. 1% threshold may not apply.
- 11) Note: Recommend TEM-NOB analysis as per EPA recommendations.
- 12) Note: Asbestos detected but not quantifiable.
- 13) Note: Multiple identical samples submitted, only one analyzed.
- 14) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.080%.
- 15) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.125%.

Recommendations for Vermiculite Analysis:

Several analytical protocols exist for the analysis of asbestos in vermiculite. These analytical approaches vary depending upon the nature of the vermiculite mineral being tested (e.g. un-processed gange, homogeneous exfoliated books of mica, or mixed mineral composites). Please contact your client representative for pricing and turnaround time options available.

iATL recommends initial testing using the EPA 600/R-93/116 method. This method is specifically designed for the analysis of asbestos in bulk building materials. It provides an acceptable starting point for primary screening of vermiculite for possible asbestos.

Results from this testing may be inconclusive. EPA suggests proceeding to a multi-tiered analysis involving wet separation techniques in conjunction with PLM and TEM gravimetric analysis (EPA 600/R-04/004).

Further information on this method and other vermiculite and asbestos issues can be found at the following: Agency for Toxic Substances and Disease Registry (ATSDR) www.atsdr.cdc.gov, United States Geological Survey (USGS) www.minerals.usgs.gov/minerals/, US EPA www.epa.gov/asbestos. The USEPA also has an informative brochure "Current Best Practices for Vermiculite Attic Insulation" EPA 747F03001 May 2003, that may assist the health and remediation professional.

The following is a summary of the analytical process outlines in the EPA 600/R-04/004 Method:

- 1) **Analytical Step/Method:** Initial Screening by PLM, EPA 600R-93/116
Requirements/Comments: Minimum of 0.1 g of sample. ~0.25% LOQ for most samples.
- 2) **Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.
- 3) **Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Floats" only.
- 4) **Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.
- 5) **Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Suspension" only.

LOQ, Limit of Quantitation estimates for mass and volume analyses.

*With advance notice and confirmation by the laboratory.

**Approximately 1 Liter of sample in double-bagged container (~9x6 inch bag of sample).

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Client: SNC483

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

APPENDIX IV

Laboratory Analytical Report (Maxxam)

Your P.O. #: 636476
Your Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC

Attention: Tim Drozda

SNC-LAVALIN INC.
BURNABY, ENVIRONMENT DIVISION
8648 COMMERCE COURT
BURNABY, BC
CANADA V5A 4N6

Your C.O.C. #: G052566, G052567, G052568, G052569, G052570

Report Date: 2016/04/01
Report #: R2151555
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B623801

Received: 2016/03/31, 16:05

Sample Matrix: Paint
Samples Received: 49

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Elements by ICP-AES (acid extr. solid)	49	2016/04/01	2016/04/01	BBY7SOP-00018	EPA 6010c R3 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key



Graham Rudkin
Project Manager, Environmental
01 Apr 2016 17:05:00 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B623801
Report Date: 2016/04/01

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

LEAD IN PAINT CHIPS (PAINT)

Maxxam ID		OJ3770	OJ3771	OJ3772	OJ3773	OJ3774	OJ3775		OJ3776		
Sampling Date		2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28		2016/03/28		
COC Number		G052566	G052566	G052566	G052566	G052566	G052566		G052566		
	UNITS	YYF-P1	YYF-P2	YYF-P3	YYF-P4	YYF-P5	YYF-P6	RDL	YYF-P7	RDL	QC Batch

Total Metals by ICP											
Total Lead (Pb)	mg/kg	5700	8350	788	8480	990	<3.0	3.0	<15 (1)	15	8230578

RDL = Reportable Detection Limit
(1) Detection limits raised due to insufficient sample volume.

Maxxam ID		OJ3777	OJ3778	OJ3779	OJ3780	OJ3781	OJ3784	OJ3785		
Sampling Date		2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28		
COC Number		G052566	G052566	G052566	G052566	G052566	G052567	G052567		
	UNITS	YYF-P8	YYF-P9	YYF-P10	YYF-P11	YYF-P12	YYF-P13	YYF-P14	RDL	QC Batch

Total Metals by ICP											
Total Lead (Pb)	mg/kg	<3.0	1780	187	<3.0	1570	1350	461	3.0	8230578	

RDL = Reportable Detection Limit

Maxxam ID		OJ3786		OJ3787	OJ3788	OJ3789	OJ3790	OJ3791		
Sampling Date		2016/03/28		2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28		
COC Number		G052567		G052567	G052567	G052567	G052567	G052567		
	UNITS	YYF-P15	QC Batch	YYF-P16	YYF-P17	YYF-P18	YYF-P19	YYF-P20	RDL	QC Batch

Total Metals by ICP											
Total Lead (Pb)	mg/kg	<3.0	8230578	50.4	18800	732	34500	337	3.0	8230676	

RDL = Reportable Detection Limit

Maxxam ID		OJ3792	OJ3793		OJ3794		OJ3795	OJ3796	OJ3797		
Sampling Date		2016/03/28	2016/03/28		2016/03/28		2016/03/28	2016/03/28	2016/03/28		
COC Number		G052567	G052567		G052567		G052567	G052568	G052568		
	UNITS	YYF-P21	YYF-P22	RDL	YYF-P23	RDL	YYF-P24	YYF-P25	YYF-P26	RDL	QC Batch

Total Metals by ICP											
Total Lead (Pb)	mg/kg	3430	4220	3.0	<15 (1)	15	173	4080	2500	3.0	8230676

RDL = Reportable Detection Limit
(1) Detection limits raised due to insufficient sample volume.

Maxxam ID		OJ3798	OJ3799	OJ3800	OJ3801	OJ3802		OJ3803		
Sampling Date		2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28		2016/03/28		
COC Number		G052568	G052568	G052568	G052568	G052568		G052568		
	UNITS	YYF-P27	YYF-P28	YYF-P29	YYF-P30	YYF-P31	RDL	YYF-P32	RDL	QC Batch

Total Metals by ICP											
Total Lead (Pb)	mg/kg	370	2110	745	19.5	<3.0	3.0	<24 (1)	24	8230676	

RDL = Reportable Detection Limit
(1) Detection limits raised due to insufficient sample volume.

Maxxam Job #: B623801
Report Date: 2016/04/01

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

LEAD IN PAINT CHIPS (PAINT)

Maxxam ID		OJ3804		OJ3805	OJ3806	OJ3807	OJ3808	OJ3809		
Sampling Date		2016/03/28		2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28		
COC Number		G052568		G052568	G052568	G052568	G052569	G052569		
	UNITS	YYF-P33	QC Batch	YYF-P34	YYF-P35	YYF-P36	YYF-P37	YYF-P38	RDL	QC Batch

Total Metals by ICP										
Total Lead (Pb)	mg/kg	524	8230676	130	1170	4810	<3.0	<3.0	3.0	8230730
RDL = Reportable Detection Limit										

Maxxam ID		OJ3810	OJ3811	OJ3812	OJ3813	OJ3814	OJ3815	OJ3816		
Sampling Date		2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28	2016/03/28		
COC Number		G052569	G052569	G052569	G052569	G052569	G052569	G052569		
	UNITS	YYF-P39	YYF-P40	YYF-P41	YYF-P42	YYF-P43	YYF-P44	YYF-P45	RDL	QC Batch

Total Metals by ICP										
Total Lead (Pb)	mg/kg	<3.0	705	952	5780	21.5	396	40.1	3.0	8230730
RDL = Reportable Detection Limit										

Maxxam ID		OJ3817	OJ3818		OJ3819		OJ3820		
Sampling Date		2016/03/28	2016/03/28		2016/03/28		2016/03/28		
COC Number		G052569	G052569		G052569		G052570		
	UNITS	YYF-P46	YYF-P47	RDL	YYF-P48	RDL	YYF-P49	RDL	QC Batch

Total Metals by ICP										
Total Lead (Pb)	mg/kg	667	<3.0	3.0	<9.0 (1)	9.0	<18 (1)	18	8230730	

RDL = Reportable Detection Limit
(1) Detection limits raised due to insufficient sample volume.

Maxxam Job #: B623801
Report Date: 2016/04/01

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Job #: B623801
Report Date: 2016/04/01

QUALITY ASSURANCE REPORT

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

QC Batch	Parameter	Date	Method Blank		RPD		QC Standard	
			Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8230578	Total Lead (Pb)	2016/04/01	<3.0	mg/kg	NC	35	95	80 - 120
8230676	Total Lead (Pb)	2016/04/01	<3.0	mg/kg	NC	35	92	80 - 120
8230730	Total Lead (Pb)	2016/04/01	<3.0	mg/kg	16	35	94	80 - 120

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).



SNC • LAVALIN

8648 Commerce Court
Burnaby, British Columbia
Canada V5A 4N6
Tel.: 604-515-5151
www.snclavalin.com

Penticton Regional Airport
Penticton ATB Roofing & Building Envelope Project
Project: R.105676.001

APPENDIX C

Federal Halocarbon Regulations, 2003



FEDERAL HALOCARBON REGULATIONS, 2003 LEAK-TEST FOR REFRIGERATION, AIR-CONDITIONING AND HALOCARBON FIRE EXTINGUISHING SYSTEMS

RÈGLEMENT FÉDÉRAL SUR LES HALOCARBURES (2003) AVIS D'ESSAIS DE DÉTECTION DES FUITES POUR LES SYSTÈMES DE CLIMATISATION ET LES SYSTÈMES D'EXTINCTION D'INCENDIE À HALON

VISIT REPORT NO. / NUMÉRO DU RAPPORT DE VISITE

IDENTIFICATION / IDENTIFICATION		
OWNER'S NAME AND ADDRESS / NOM DU PROPRIÉTAIRE ET L'ADRESSE* :		OPERATOR'S NAME / NOM DE L'OPÉRATEUR* :
SERVICE TECHNICIAN'S NAME / NOM DU TECHNICIEN D'ENTRETIEN* :	SERVICE TECHNICIAN'S PROFESSIONAL CERTIFICATE NO. / NUMÉRO DE CERTIFICAT PROFESSIONNEL DU TECHNICIEN D'ENTRETIEN :	SERVICE TECHNICIAN'S AWARENESS CERTIFICATE NO. / NUMÉRO DE CERTIFICAT DE SENSIBILISATION DU TECHNICIEN D'ENTRETIEN* :
NAME OF SERVICE TECHNICIAN'S EMPLOYER / NOM DE L'EMPLOYEUR DU TECHNICIEN D'ENTRETIEN		

LOCATION / LOCALISATION*	TYPE / TYPE*	DESCRIPTION / DESCRIPTION*	
ADDRESS OR BUILDING NO. / ADRESSE OU NUMÉRO D'ÉDIFICE* 	<input type="checkbox"/> AIR-CONDITIONING / CLIMATISATION <input type="checkbox"/> REFRIGERATION / RÉFRIGÉRATION <input type="checkbox"/> HALOCARBON	MAKE / MARQUE* :	
		MODEL / MODÈLE* :	
		SERIAL NO. / NUMÉRO DE SÉRIE	
FLOOR OR ROOM NO. / ÉTAGE OU NUMÉRO DE LA SALLE* :	EXTINGUISHER / EXTINCTEUR D'INCENDIE À HALON	SYSTEM'S CHARGING CAPACITY / CAPACITÉ DE CHARGE DU SYSTÈME KG	REFRIGERATION CAPACITY / PUISSANCE FRIGORIFIQUE KW

TYPE OF ACTIVITY / TYPE D'ACTIVITÉ			
DATE (YYYY/MM/DD) / DATE* (AAAA/MM/JJ) :	<input type="checkbox"/> ANNUAL MAINTENANCE / ENTRETIEN ANNUEL	<input type="checkbox"/> LEAK-TEST / ESSAIS DE DÉTECTION DES FUITES	
<input type="checkbox"/> LEAK TEST / ESSAIS DE DÉTECTION DES FUITES	LEAK DETECTED / FUITE DÉTECTÉE <input type="checkbox"/> YES / OUI <input type="checkbox"/> NO / NON		
	DATE OF TWO LAST TESTS (YYYY/MM/DD) / DATE DE DEUX DERNIERS ESSAIS (AAAA/MM/JJ)	DETECTION METHOD (SPECIFY) / MÉTHODE DE DÉTECTION (SPÉCIFIÉ)	
<input type="checkbox"/> REPAIR / RÉPARATION	LEAK REPAIRED / FUITE RÉPARÉE <input type="checkbox"/> YES <input type="checkbox"/> NO		LEAK REPAIR DATE (YYYY/MM/DD) / DATE DE RÉPARATION DE LA FUITE* : (AAAA/MM/JJ) _____
	SYSTEM RECHARGED / SYSTÈME RECHARGÉ : <input type="checkbox"/> YES <input type="checkbox"/> NO	VOLUME RECHARGED / VOLUME RECHARGÉ	TYPE OF HALOCARBON (IF DIFFERENT) / TYPE D'HALOCARBURE (SI DIFFÉRENT)
	HALOCARBON RECOVERED / HALOCARBURE RÉCUPÉRÉ <input type="checkbox"/> YES <input type="checkbox"/> NO	VOLUME RECHARGED / VOLUME RECHARGÉ	



<input type="checkbox"/> OTHER (SPECIFY) / AUTRE (SPECIFIÉ) : _____	
ADDITIONAL INFORMATION/REMARKS / INFORMATION/REMARQUES ADDITIONNELLES	
SERVICE TECHNICIAN'S SIGNATURE / SIGNATURE DU TECHNICIEN D'ENTRETIEN	DATE (YYYY/MM/DD) / DATE (AAAA/MM/JJ)

*: Required under the FHR / Requis en vertu du RFH

Important / Important

- 1- Affix a copy of the notice to the system / Apposez une copie de l'avis sur le système
- 2- Fill out the service log based on the information in the notice / Remplissez le registre d'entretien basé sur l'information dans l'avis



DATE / DATE (YYYY/MM/DD) / (AAAA/MM/JJ)	SERVICE TECHNICIAN/ CERTIFIED PERSON / TECHNICIEN D'ENTRETIEN/ PERSONNE ACCREDITÉE	EMPLOYER / EMPLOYEUR*	CERTIFICATE NO. / NUMÉRO DE CERTIFICAT* :	REPORT NO. / NUMÉRO DE RAPPORT	ACTIVITY / ACTIVITÉ*
REMARKS / REMARQUES					

*: Required under the Federal Halocarbon Regulation 2003 / Requis en vertu du Règlement fédéral sur les halocarbures (2003)



**FEDERAL HALOCARBON REGULATIONS, 2003
SYSTEM DISMANTLING, DECOMMISSIONING OR DESTRUCTION NOTICE**

**RÈGLEMENT FÉDÉRAL SUR LES HALOCARBURES (2003)
AVIS DE DESTRUCTION, DE DÉSASSEMBLAGE OU DE MISE HORS SERVICE
D'UN SYSTÈME CONTENANT UN HALOCARBURE**

IDENTIFICATION / IDENTIFICATION		
OWNER'S NAME AND ADDRESS / NOM ET ADRESSE DU PROPRIÉTAIRE* :		OPERATOR'S NAME / NOM DE L'OPÉRATEUR
SERVICE TECHNICIAN'S NAME / NOM DU TECHNICIEN D'ENTRETIEN	SERVICE TECHNICIAN'S PROFESSIONAL CERTIFICATE NO. / NUMÉRO DE CERTIFICAT PROFESSIONNEL DU TECHNICIEN D'ENTRETIEN :	SERVICE TECHNICIAN'S AWARENESS CERTIFICATE NO. / NUMÉRO DE CERTIFICAT DE SENSIBILISATION DU TECHNICIEN D'ENTRETIEN* :
NAME OF SERVICE TECHNICIAN'S EMPLOYER*:		

LOCATION / LOCALISATION*	TYPE / TYPE*	DESCRIPTION / DESCRIPTION*	
ADDRESS OR BUILDING NO. / ADRESSE OU NUMÉRO D'ÉDIFICE* :	<input type="checkbox"/> AIR-CONDITIONING / CLIMATISATION <input type="checkbox"/> REFRIGERATION / RÉFRIGÉRATION <input type="checkbox"/> HALOCARBON EXTINGUISHER / EXTINCTEUR D'INCENDIE À HALON	MAKE / MARQUE* :	
		MODEL / MODÈLE* :	
		SERIAL NO. / NUMÉRO DE SÉRIE	
FLOOR OR ROOM NO. / ÉTAGE OU NUMÉRO DE LA SALLE*		SYSTEM'S CHARGING CAPACITY / CAPACITÉ DE CHARGE DU SYSTÈME KG	REFRIGERATION CAPACITY / PUISSANCE FRIGORIFIQUE : kW

INFORMATION / INFORMATION		
TYPE OF HALOCARBON RELEASED / TYPE D'HALOCARBURE REJETÉ*	VOLUME RECOVERED / VOLUME RÉCUPÉRÉ KG	DATE OF RECOVERY (YYYY/MM/DD) / DATE DE RÉCUPÉRATION (AAAA/MM/JJ)*
SYSTEM'S FINAL DESTINATION (IF APPLICABLE) / DESTINATION FINALE DU SYSTÈME (SI APPLICABLE)		
REMARKS / REMARQUES		



FILLED OUT BY / REMPLI PAR	SIGNATURE / SIGNATURE	DATE (YYYY/MM/DD) / DATE (AAAA/MM/JJ)
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*: Required under the FHR

Important:

- 1- Affix a copy of the notice to the system before starting the work
- 2- Fill out the Service Log based on the information in this notice