Division 01 - General Requirements

Division 02 – Existing Conditions

Division 05 – Metals

Division 06 – Wood, Plastics and Composites

Division 07 – Thermal and Moisture Protection

Division 08 – Openings

Division 25 – Integrated Automation

Division 26 – Electrical

APPENDIX A

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Bid Package comprises of renovations to Maintenance Compound Roofs and upgrades to the mechanical and electrical systems as indicated in the drawings and specs, located at 216 Hawk Avenue, Banff, Alberta.

.2 Coordinate Work with hazardous materials with the hazardous materials assessment which are included in appendix.

.3 Perform Work in accordance with National Building Code of Canada (NBC) 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.

.4 Perform Work in accordance with National Parks Act when projects are located within boundaries of National Park.

1.2 SUMMARY OF WORK

.1 This project includes work in both the garage building and the warden's building. The garage building scope generally includes an upgrade of the mechanical systems including replacement of roof top units, exhaust fans, ductwork modifications with electrical modifications to support the changes as indicated in the drawings and specs. Also included is the removal and disposal of the existing low slope roof membrane, repairs to the existing wood deck including patching and making good any redundant roof openings and to install a new conventional low-slope 2-ply SBS modified bituminous roof assembly and to conduct the work as indicated in the drawings and specs.

The trades and warden's building scope generally includes an upgrade of the mechanical systems including replacement of roof top units, exhaust fans and ductwork modifications with electrical modifications to support the changes as indicated in the drawings and specs. Also included is the removal and disposal of the existing boilers in both the wardens and trades wings with replacement to include a redundant system located in the trades wing. Additionally the existing low slope roof membrane is to be removed and disposed of and the existing wood deck is to be repaired as necessary, including patching and making good any unneeded roof openings from redundant roof top equipment and/or skylights. Install a new conventional low-slope 2-ply SBS modified bituminous roof assembly and conduct the work as indicated in the drawings and specs and as follows:

.1 Examine drawings and specifications to ascertain the scope of work. Refer to manufacturer's written product application data as it relates to this project.

.2 Contractor to recycle existing pre-finished metal flashings and rigid insulation, if possible, and provide a letter to the Departmental Representative documenting the method these components were removed, discarded, and/or recycled.

.3 Cut and remove existing stucco wall finish according to the Detail Drawings to allow for termination of new stripping plies at roof and parapet wall-to-high wall transitions.

.4 Install mechanically-fastened dimensional wood blocking to ensure the existing duct work sleeper supports are a minimum of 200 mm above the finished height of the new primary roof membrane.

.5 Remove and dispose of all existing roof assembly components including:, waterproofing gum boxes, cant strips, roof drains, drain clamping rings, drain debris domes, asphalt flood coat, roof membrane and stripping plies, fiberboard, rigid insulation, vapour retarder, gypsum deck levelling board, all dimensional wood curb blocking, dirt, dust, and debris.

.6 The Departmental Representative will identify any existing equipment to be removed during the Pre-Tender site meeting.

.7 Cut and modify the existing bases of the exterior fixed metal roof access ladders to allow for the installation of new roof assembly components. Prime and paint (colour-matched) any modified ladder sections.

.8 Install new 12.7 mm mechanically fastened, non-treated plywood at all roof to high wall transitions, interior parapet wall face, and parapet wall caps. New plywood parapet caps are to slope a minimum of 5% back into the field of the roof.

.9 Curb all existing roof penetrations and roof top unit service line penetrations to be re-used except for internal roof drain locations. The installation of waterproofing gum boxes will be rejected. All roof penetration curbs and dimensional wood sleeper supports are to extend to minimum height of 200 mm above the finished level of the new primary roof membrane.

.10 Isolate all electrical and mechanical roof top unit (RTU) service lines (e.g. tech cables, gas, and refrigerant lines) within their own roof penetration curbs. RTU Service lines are to exit the vertical face of the curbs a minimum of 200 mm above the finished height of the torch-applied SBS modified bitumen cap sheet. Fluid-applied and fabric reinforced membrane flashings are to be installed from the surface of the cap stripping onto the service line(s) where exiting the curb face.

.11 Install new, mechanically fastened dimensional wood-framed curbs (see architectural drawings for sizes) around all existing plumbing vent pipe roof penetrations. Mechanically-fasten new wood curbs directly to the existing wood decks. Insulate new curb cavities with new batt insulation. Seal new vapour retarder extensions onto the vertical surfaces of the plumbing vent pipes inside the curb cavities. Curb heights are to be a minimum of 200 mm above the finished height of the new primary roof membrane.

.12 Install new mechanically-fastened, conical aluminum plumbing vent pipe curb flashings (e.g. Waterline) complete with neoprene collars. Neatly fold and secure corners of the aluminum flashings a minimum of 50 mm over the top of the curbs and secure with a minimum of two pan head screws per side. Install ‘finger tooled’ sealant over the neoprene collar-to-plumbing vent pipe transitions. Extend existing plumbing vent pipes to a height of 100 mm above the aluminum flashings’ neoprene collars. Seal plumbing vent pipe extensions to existing vent bells with urethane sealant.

.13 Install new mechanically-fastened dimensional wood-framed curbs around all existing ‘B’ vent pipe and goose neck vent roof penetrations.

Install new mechanically-fastened, one-piece, welded metal square-to-round flashings complete with new metal storm collars and urethane sealant.

.14 Clean all dirt, dust, and debris from the surfaces of the existing fluted steel decks and existing wood decks prior to installing new adhered 12.7 mm exterior grade gypsum leveling board to the existing fluted steel decks. Install new deck leveling board in stripes of the membrane manufacturer's recommended low-rise foam adhesive. Stagger end joints of the new deck leveling board a minimum of 300 mm.

.15 Install new primer and fire prevention tape over all exterior gypsum, prime leveling board side and end joints and at horizontal-to-vertical transitions (e.g. parapets, roof penetration curbs, and high walls).

.16 Install new roofing in accordance with Section 07 52 00.

.17 Install new pre-finished metal flashing details according to the Drawings and Section 07 62 00.

.18 Install new torch-applied, granulated, SBS modified bitumen pedestrian cap sheet protection layers at the top and bottom of all fixed metal roof access ladders. De-granulate underlying cap sheet prior to torch application of 1000 mm x 1000 mm protective cap sheets at locations as indicated on drawings. Colour of traffic cap sheet walkway to be approved by the Departmental Representative and to be different than the roof fields' new torch-applied SVS modified bitumen cap sheet.

.19 Reconnect all existing roof top and wall-mounted service lines (e.g. gas lines, electrical, and conduit) after new roof assembly component installation is complete.

.20 All existing roof top unit service lines (e.g. gas lines, refrigerant, etc.) are to be raised and supported by new rubber molded C-port equipment sleepers if required. Install new C-port sleepers on top of additional loose-laid SBS modified bitumen cap sheet protection pads. Reinstall existing service lines.

.21 All torch equipment used for hot works on this roof replacement project are to be fitted with an automatic shut-off device.

.22 Install temporary safety railing in accordance with Alberta OH & S regulations complete with debris screens along the roof edges.

.23 Include all costs for mechanical and electrical work of the project.

.24 Supply a written and signed manufacturers fifteen (15) year warranty in accordance with Section 07 52 00.

.25 Remove existing skylight and provide new skylights as indicated on drawings.

.26 Provide new access hatch for Garage roof. Remove and reinstall roof access hatch on Compound Building.

.27 Coordinate shutdown of the existing power service , when needed with building maintenance. Shutdown times and duration to be kept to a minimum, and to be per Departmental Representatives requirement. Do work requiring shutdown after normal operating hours or on weekends if deemed necessary.

.28 Trace all existing remaining energized electrical power including underground as required. Adjust routing of new conduit if required, re-

route or protect existing remaining conduit entering construction area. Repair if damaged.

.29 Provide all cutting of existing floor, walls, and ceiling required for electrical demolition and new installation.

.30 Contractor shall be responsible for all repairs and patching of existing floors, walls, and ceilings damaged by electrical installation. Coordinate cutting and patching of existing floors, ceilings and walls with related sub trades.

.31 All wiring, disconnect switches, conduit, starters and other related electrical requirement for the mechanical connection shall be provided by the electrical contractor. Refer to mechanical drawings for exact locations of motors, thermostat etc. and make final connections.

.32 Visit the site, thoroughly examine and get familiar with the existing systems and installation and every condition which may affect the work. No claims for extra will be allowed for work or materials necessary for proper execution and completion of the contract or for the bidder's failure, error or negligence in this regard or for work necessitated by conditions ordinarily evident on the site.

.33 Provide new HVAC equipment, including air handling units, makeup air units, and exhaust fans, to replace existing units as indicated.

.34 Revise existing ventilation systems where necessary to serve new occupied spaces and existing under-ventilated spaces; where required, provide associated reheat coils, low-velocity ductwork, fire dampers, hydronic piping, control, isolation and balancing valves

.35 Revise existing engine exhaust systems, increasing exhaust and makeup air volumes where necessary to accommodate desired vehicle service requirements.

.36 Duct garage makeup air supply to discharge into occupied space.

.37 Provide fire dampers where ducts cross existing fire rated assemblies.

.38 Revise existing exhaust systems to serve shower and print room areas.

.39 Clean and rebalance existing HVAC duct and hydronic systems.

.40 Provide new heating plant equipment, including boilers, pumps, valves, and trim as indicated; revise existing heating water distribution to reverse return configuration where indicated.

.41 Replace existing control system(s) with a new central DDC building automation system; provide new controllers, wiring, sensors, actuators, valves, dampers, and associated devices required to implement new control system.

1.3 CONTRACT METHOD

.1 Construct Work under single stipulated price contract.

1.4 WORK SCHEDULE

.1 Initiate work of this project as soon as letter of acceptance is received.

.2 Complete Work by August 31, 2017

.3 No compensation will be provided to Contractor for cold weather work or other weather related costs.

1.5 SURVEY OF EXISTING PROPERTY CONDITIONS

.1 Submission of tender is deemed to be confirmation that the Contractor has inspected the site and is conversant with all conditions affecting execution and completion of work.

.2 The Contractor shall regularly monitor the condition of the Work Site and of property on and adjoining the Work Site throughout the construction period, and shall immediately notify the Owner if any deterioration in condition is detected. Such monitoring shall cover all pertinent features and property including, but not limited to, buildings, structures, roads, walls, fences, slopes, sewers, culverts and landscaped areas.

1.6 WORK BY OTHERS

.1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.

.2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

.3 Work of Project executed during Work of this Contract, and which is specifically excluded from this Contract:

.1 IT equipment and antennae’s and wiring removed from roof.

1.7 WORK SEQUENCE

.1 Construct Work in stages to accommodate Departmental Representative's continued use of premises during construction.

.2 Co-ordinate Progress Schedule and co-ordinate with Departmental Representative Occupancy during construction.

.3 Required stages:

.1 Removal of roof top units shall be in stages – not all at once. Coordinate schedule of removal with Departmental Representative. Provide detailed construction schedule with dates of shut down of various areas of the building HVAC system.

.2 All efforts possible must be made to reduce the time equipment is off-line to a maximum or two (2) hours. Prepare in advance prior to all equipment being taken off line, all service lines, junctions and reconnection points so there is a rapid reconnection after equipment is relocated to roof. If equipment is off line for longer than the 2 hours the contractor must make temporary arrangements to heat and exhaust affected spaces.

.4 Maintain fire access/control.

1.8 CONTRACTOR USE OF PREMISES

.1 Limit use of premises for work, storage, and access to allow Departmental Representative Occupancy.

.2 Co-ordinate use of premises under direction of Departmental Representative.

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

.4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

.5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.

.6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.9 DEPARTMENTAL REPRESENTATIVE OCCUPANCY

.1 Departmental Representative will occupy premises during entire construction period for execution of normal operations.

.2 Co-operate with Departmental Representative in scheduling operations to minimize conflict and to facilitate Departmental Representative usage.

1.10 ITEMS PURCHASED OUTSIDE THIS CONTRACT

.1 Departmental Representative Responsibilities:

.1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to Contractor.

.2 Deliver supplier's bill of materials to Contractor

.3 Arrange and pay for delivery to site in accordance with Progress Schedule.

.4 Inspect deliveries jointly with Contractor.

.5 Submit claims for transportation damage.

.6 Arrange for replacement of damaged, defective or missing items.

.7 Arrange for manufacturer's field services; arrange for and deliver manufacturer's warranties and bonds to Contractor.

.2 Contractor Responsibilities:

.1 Designate submittals and delivery date for each product in progress schedule.

.2 Review shop drawings, product data, samples, and other submittals. Submit to Departmental Representative notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.

.3 Receive and unload products at site.

.4 Inspect deliveries jointly with Departmental Representative; record shortages, and damaged or defective items.

.5 Handle products at site, including uncrating and storage.

.6 Protect products from damage, and from exposure to elements.

.7 Assemble, install, connect, adjust, and finish products.

.8 Provide installation inspections required by public authorities.

.9 Repair or replace items damaged by Contractor or subcontractor on site (under his control).

1.11 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy each document as follows:

.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Reviewed Shop Drawings.
.5 List of Outstanding Shop Drawings.
.6 Change Orders.
.7 Other Modifications to Contract.
.8 Field Test Reports.
.9 Permits
.10 Copy of Approved Work Schedule.
.11 Health and Safety Plan and Other Safety Related Documents.
.12 Other documents as specified.

1.12 Payment

.1 This is a Fixed Price Contract

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 INTENT

.1 The Work shall be designed, constructed, and commissioned in a manner which is compliant with the Canada National Parks Act and Parks Canada Agency Regulations, Directives, and Guidelines.

.2 Permits are required from Parks Canada and the authority having jurisdiction.

1.2 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 Limit laydown area to an area agreed with by Departmental Representative.

1.3 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 Provide sanitary facilities for use by Contractor's personnel. Keep facilities clean.

.5 Closures: protect work temporarily until permanent enclosures are completed.

.6 Set up office-tool trailer on site.

.7 Keep Site clean and free from accumulation of waste materials and rubbish regardless of source. Remove snow as necessary and at Contractors cost for the performance and inspection of the Work.

.8 Repair damage to the Work Site caused by the Contractor at Contractors expense.

.9 Hours of Work: Monday to Friday, 7.30am – 9.00pm, Saturday, 10.00am – 10.00pm.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.5 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 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

.3 Provide alternative routes for personnel, pedestrian, and vehicular traffic as required.

.4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.

.5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.

.7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

.9 Record locations of maintained, re-routed and abandoned service lines.

.10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 SPECIAL REQUIREMENTS

.1 Submit schedule in accordance with Section 01 32 16 – Construction Schedule.

.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 Coordinate times for delivery of materials with Departmental Representative.

1.7 BUILDING SMOKING ENVIRONMENT

.1 Smoking is not allowed on Site.

1.8 SUPERVISORY PERSONNEL

.1 In accordance with Government of Canada GC 2.6 R28Z0D, within five Days after award notification, the Contractor shall submit to the Departmental Representative confirmation of the names of the supervisory personnel and other key staff designated for assignment on the Contract.

.2 The following personnel shall be included in the list:

.1 Project Superintendent.

.2 Safety Representative.

.3 Provide the name(s) of the supervising stone mason, complete with a full résumé of experience and references for work completed on designated historic masonry structures.

.3 The above personnel shall perform the following duties:

.1 The Project Superintendent shall be employed full time and shall be present on the Work Site each and every workday that Work is being performed, from the commencement of Work to Total Performance of the Work.

.2 The Project Superintendent shall nominate a Deputy Project Superintendent who shall have the authority of the Project Superintendent during the latter's absence.

.3 The Safety Representative shall possess safety experience in general construction. Duties shall encompass all matters of safety activities from commencement of Work until the Total Performance of the Work.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

.1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Departmental Representative are specified under various sections.

1.2 APPOINTMENT AND PAYMENT

.1 Departmental Representative will appoint and pay for services of testing laboratory except follows:

- .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
- .2 Inspection and testing performed exclusively for Contractor's convenience.
- .3 Testing, adjustment and balancing of mechanical and electrical equipment and systems.
- .4 Mill tests and certificates of compliance.
- .5 Tests specified to be carried out by Contractor under the supervision of Departmental Representative.
- .6 Additional tests specified as required.

.2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Departmental Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

.1 Provide labour, equipment and facilities to:

- .1 Provide access to Work for inspection and testing.
- .2 Facilitate inspections and tests.
- .3 Make good Work disturbed by inspection and test.
- .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Departmental Representative sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

.3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Coordinate between mechanical and electrical work, and work of other affected Sections in accordance with the requirements of this Section and other affected sections.

1.2 MECHANICAL-ELECTRICAL WORK COORDINATOR

.1 Contractor shall be responsible for providing a person technically qualified and experienced in field coordination for the type of mechanical and electrical work required for this Project, for duration of construction work.

.2 Mechanical and Electrical Coordination shall be performed by a dedicated person other than the Contractor's Project Manager; who shall have extensive experience with coordinating complex mechanical and electrical work and shall be acceptable to the Departmental Representative.

1.3 SUBMITTALS

.1 Provide required coordination documents before submitting shop drawings, product data and samples; provide information required by this Section in accordance with Section 01 33 00.

.2 Preparation of Mechanical and Electrical Coordination specified in this Section form a part of the Contractor's Submission requirements as follows:

.1 Mechanical and Electrical Subcontractors shall allow for full assistance and cooperation with the General Contractor in the provision of all required information for the assembly of Coordination Drawings.

.2 Mechanical and Electrical Coordination Drawings described in this Section form a part of the General Contractor's Scope-of-Work.

.3 Submit name, qualifications, and related experience of proposed Mechanical-Electrical Coordinator to the Departmental Representative before any Work starts on site; Departmental Representative reserves the right to reject any candidate that does not appear suitable for this Project.

.4 Submit field coordination drawings for mechanical and electrical work above ceilings for all floor levels, including penthouse and mechanical and electrical rooms, supplemented with building cross sections indicating mechanical and electrical systems fully coordinated with structural drawings and details, and coordinated with architectural finish components such as ceilings, bulkheads, furring, casework and equipment, indicating ductwork, piping, conduit, and equipment in their intended locations, coordinated with all other parts of the Work and highlighting potential interference between systems and building components.

Part 2 Products

2.1 COORDINATION DOCUMENTS

.1 Prepare Field Coordination Plan and Section Drawings indicating coordination for the following:

.1 Scale:

.1 Plans: Not less than 1:50 metric.

.2 Sections: Not less than 1:20 metric.

.3 Details: Not less than 1:10 metric.

.2 Clearly indicate changes to the location, direction, route or grade of mechanical and electrical work shown in the Contract Documents that are required or necessary arising from the coordination of the Work.

.3 Reproduce and distribute copies at Coordination Meeting to each concerned party in accordance with Section 01 31 19.

.4 Update and revise as necessary after each Coordination Meeting.

.2 Maintain coordination documents throughout construction period, recording changes arising from modifications and adjustments; submit finalized coordination documents after completion of Project in accordance with Section 01 78 00.

2.2 ELECTRICAL GENERAL PROVISIONS

.1 All electrical components shall be disconnected and reconnected in accordance with the Canadian Electrical Code 2006, Part 1.

.2 All electrical work required in the removal of the existing roof assembly and installation of new roof assembly components shall be performed by a licensed contractor.

.3 Notify Departmental Representative immediately of all existing wiring methods which are not in accordance with the Canadian Electrical Code 2006, Part 1.

.4 Temporarily disconnect, remove, and/or support all existing conduit servicing roof top equipment to allow for removal of existing roof assembly components and installation of new roof assembly components. Reconnect upon completion of new roof assembly installation.

.5 Move rooftop appurtenances to facilitate curbing and flashing to the required height. Disconnection, lifting, re-connection, and start-up of the utilities shall be done by the Contractor at his expense.

2.3 MECHANICAL GENERAL PROVISIONS

.1 On existing fans: curbs to be extended to a minimum elevation of 200 mm above the new primary roof membrane. Exhaust duct drop to be extended as required accommodating new curb height. Exhaust duct drop to be insulated as required accommodating new curb height. Seal ductwork for airtight seal.

.2 Remove all debris from vents by pulling out debris from a point no less than 600 mm below roof membrane. Vents which are known to the contractor to be blocked beyond 600 mm below roof membrane. Identify each in a manner acceptable to the Departmental Representative.

.3 Curb all plumbing vent pipe roof penetrations to a minimum height of 200 mm from the finished level of the SBS modified bitumen cap sheet. Insulate curb interiors with batt insulation . Install new spun aluminum roof jacks with integral collars on the plumbing vent roof penetration curbs. Plumbing vent pipes are to extend to a maximum height of 100 mm above the finished height of the neoprene collars. Install new sealed plumbing vent pipe extensions as required.

.4 Remove and discard all existing internal roof drain assemblies complete with debris domes and clamping rings.

.5 Install new coated, cast metal internal roof drains complete with cast metal clamping rings (include for underdeck clamping rings), cast metal debris domes and all related accessories to provide watertight seals to the existing interior rain water leaders.

.6 Install new secured interior rain water leader insulation and wrap extending from the new internal roof drains extending a minimum of three (3) metres away from the drains.

.7 All mechanical work to be conducted by a licensed contractor.

Part 3 Execution

3.1 MECHANICAL AND ELECTRICAL COORDINATION

.1 Coordinate work.

.2 Coordinate progress schedules, including dates for submittals and for delivery of products.

.3 Conduct conferences between Subcontractors, other contractors and other concerned entities as necessary to establish and maintain coordination and schedules and to resolve matters identified by coordination activities.

.4 Participate in Progress and Coordination Meetings; report on work requiring adjustment under coordination requirements, and any needed changes in schedules or in the work to resolve interferences between components of the Work.

.5 Transmit minutes of coordination to all attendees and concerned individuals in accordance with Section 01 31 19.

.6 Implementation of changes required as a result of coordination activities shall be performed as follows:

.1 Work Considered as No Change to Contract: Changes that **do not** materially increase or decrease the Scope-of-Work of the Contract, shall not be considered as additional work under Contract.

.2 Work Considered as Change to Contract: Changes that **do** materially increase or decrease the Scope-of-Work of the Contract, will be administered as a Change to the Contract in accordance with General Conditions of Contract.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Schedule and administer project meetings throughout the progress of the work as requested by the Departmental Representative.

.2 Departmental Representative shall prepare agenda for meetings.

.3 Departmental Representative shall distribute written notice of each meeting four days in advance of meeting date to all parties.

.4 Contractor to provide physical space and make arrangements for meetings in coordination with Departmental Representative.

.5 Departmental Representative to preside at meetings.

.6 Departmental Representative shall record the meeting minutes and include significant proceedings and decisions with identification of actions by parties.

.7 Departmental Representative shall reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and, affected parties not in attendance.

.8 Representative of Departmental Representative, Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

.1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of Departmental Representative, Departmental Representatives, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.

.4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Introduction
.2 Project Control – names, authority, responsibility
.3 Chain of Command
.4 Work Schedule
.5 Dewatering
.6 Available Utilities – Telephone, Hydro, etc.
.7 Contractor’s and Department’s Field Offices

.8 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.9 Township and Park – cooperation and contacts

.10 Public Utilities – cooperation, investigations, contacts

.11 Project Sign

.12 Surveys – responsibilities

.13 Extra plans and specifications

.14 Record Drawings

.15 As-Built Drawings

.16 Subtrades and Contractors

.17 Access

.18 Correspondence

.19 Testing – Consultant, in-house, for commissioning

.20 Contractor to supply information or alternates prior to ordering

.21 Overtime

.22 Project Boundary

.23 Restoration of Damaged Areas

.24 Work by Others

.25 Park Responsibilities

.26 Inform Workers of Park Rules – garbage, wildlife

.27 Washroom Facilities

.28 Site Meetings – schedules, minutes

.29 Contract Forms

.30 Request for Payment – Procedures

.31 Dump Site

.32 Blasting

.33 Permits

.34 Bonds and Insurance

.35 Soils Reports

.36 O & M Manuals

.37 Guarantees

.38 Daily Clean up

.39 Department of Labour re: safety

.40 Salvage and Store Existing Parks Equipment

.41 Specific Questions re: units of contract

1.3 PROGRESS MEETINGS

.1 During course of Work and 2 weeks prior to project completion, schedule progress meetings every two weeks.

.2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.

.3 Notify parties minimum 7 days prior to meetings.

.4 Departmental Representative to record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days after meeting.

.5 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, conflicts.
.4 Problems which impede construction schedule.
.5 Review of off-site fabrication delivery schedules.
.6 Corrective measures and procedures to regain projected schedule.
.7 Revision to construction schedule.
.8 Progress schedule, during succeeding work period.
.9 Review submittal schedules: expedite as required.
.10 Maintenance of quality standards.
.11 Review proposed changes for affect on construction schedule and on completion date.
.12 Review health and safety issues.
.13 Review environmental issues.
.14 Other business.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

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

.2 Submit to Departmental Representative within 15 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

1.4 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:

.1 Award.
.2 Shop Drawings, Samples.
.3 Permits.
.4 Mobilization.
.5 Hazardous Materials Abatement
.6 Demolition of Structures
.7 Siding and Roofing.
.8 Plumbing.
.9 Lighting.
.10 Electrical.
.11 Piping.
.12 Controls.
.13 Removal and replacement of roof top units.
.14 Heating, Ventilating, and Air Conditioning.
.15 Fire Systems.
.16 Testing and Commissioning.
.17 Supplied equipment long delivery items.
.18 Engineer supplied equipment required dates.

1.5 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule every two weeks reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.6 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit 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.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

1.2 REQUIRED CONTRACTOR SUBMITTALS

.1 General

.1 This Clause identifies the plans, programs, and documentation required prior to mobilization on site and during the construction phase.

.2 Pre-Mobilization Submittals: The Contractor shall not begin any site Work until the Departmental Representative has authorized acceptance of submittals. Submit the following plans and programs to the Departmental Representative for review prior to mobilization to the project site:

.2 Project schedule.

.1 List of subcontractors, suppliers and consultants, their role and their key personnel, including names and positions, addresses, telephone and cellular telephone numbers, as requested by Departmental Representative.

.2 Plan describing methods the Contractor will have to meet his responsibilities as the Prime Contractor for Traffic Control in the Work zones.

.3 Contractor Chain of Command, listing key Contractor personnel, including for each name, position, qualification, experience, telephone, cellular telephone and numbers. The list shall include the names and telephone/cellular telephone numbers for contact persons who are available on a 24-hour basis in the event of emergencies.

.4 Contractor shall develop an “Emergency Procedures Protocol” in consultation with Parks Canada.

.3 Construction Phase Submittals

.1 Progress Reports that outline the detailed Work (Contractor, subcontractors, suppliers, consultants) completed to date as well as the anticipated Work to be performed for the following week. Also, alternate Work to be identified if Work or a portion of, proposed cannot be done due to weather, equipment breakdown, delays in delivery, etc.

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

.3 Submit copies of incident and accident reports.

.4 The Contractor shall not construe the Departmental Representative’s authorization of the submittals to imply approval of any particular method or sequence for conducting the Work, or for addressing health and safety concerns. Authorization of the programs shall not relieve the Contractor from the responsibility to conduct the Work in strict accordance with the requirements of Federal or Provincial regulations, this specification, or to adequately protect the health and safety of all workers involved in the project and any members of the public who may be affected by the project. The Contractor shall remain solely responsible for the adequacy and completeness of the programs and work practices, and adherence to them.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Alberta, Canada.

.3 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 co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 6 working days for Departmental Representative's review of each submission.

.5 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.

.6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions 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.

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

.10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit electronic copies 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.

.12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.17 Delete information not applicable to project.

.18 Supplement standard information to provide details applicable to project.

.19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that Departmental Representative 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 requirements of construction and Contract Documents.

.2 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 sub-trades.

1.4 SAMPLES

.1 Submit for review samples in duplicate or as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples to Departmental Representative at site meetings or by Courier.

.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 PHOTOGRAPHS: DIGITAL FORMAT

.1 Progress Photographs

.1 Sizes: minimum 2 mega pixel image file size, jpeg image file.

.2 Format: CD or DVD (*.jpg).

.3 Viewpoints: A minimum of four (4) photographs from three (3) different viewpoints will be required.

.4 Number of photo sets: one (1) set per week.

.5 Identification: referenced to photo file with name, location, purpose, and number of project and date of exposure.

.6 Viewpoints: interior and exterior locations: viewpoints determined by Departmental Representative.

.7 Frequency: at completion of each phase of the construction and services before concealment and at completion of each discrete phase of construction.

.8 Distribution: post photographs to folder as indicated by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

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

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

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

.1 Material Safety Data Sheets (MSDS).

.3 Province of Alberta

.1 Occupational Health and Safety Code 2009.

1.2 SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Consultant and authority having jurisdiction, weekly.

.4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets.

.7 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within 7 days after receipt of comments from Consultant.

.8 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 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 Consultant

.10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 PROTECTION OF PERSONS AND PROPERTY

.1 Comply with all applicable safety regulations of the Workers' Compensation Board of Alberta (WCB) including, but not limited to, WCB's Industrial Health and Safety Regulations, Industrial First Aid Regulations, and Workplace Hazardous Materials Information System Regulations.

.2 The Contractor shall take all necessary precautions and measures to prevent injury or damage to persons and property on or near the Work Site.

.3 The Contractor shall promptly take such measures as are required to repair, replace or compensate for any loss or damage caused by the Contractor to any property or, if Parks Canada so directs, shall promptly reimburse to Parks Canada the costs resulting from such loss or damage.

1.4 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.5 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.6 MEETINGS

.1 Schedule and administer Health and Safety meeting with Consultant and Owner prior to commencement of Work.

1.7 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

.1 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.

.2 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.

1.9 COMPLIANCE REQUIREMENTS

.1 Comply with Occupational Health and Safety Act of Alberta.

1.10 UNFORSEEN HAZARDS

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Consultant verbally and in writing.

1.11 PRIME CONTRACTOR

.1 Responsibility for Work Site Safety - This Contractor Is "Prime Contractor":

.1 The Contractor shall, for the purposes of the Occupational Health and Safety Act (Alberta), and for the duration of the Work of this Contract:

.1 Be the "Prime Contractor" for the "Work Site", and

.2 Meet all requirements of the Occupational Health and Safety Act and Regulations, Workers Compensation Board legislation, the Fire Code legislation and all other applicable laws that govern work place safety.

.2 The Contractor shall direct all Subcontractors, sub-subcontractors, Other Contractors, employees, suppliers, 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, regardless of:

.1 Whether or not any contractual relationship exists between the Contractor and any of these entities, and

.2 Whether or not such entities have been specifically identified in this Contract.

.3 Safety Certification: Safety certification is a condition of contract award; Contractor is required to maintain a valid Certificate of Recognition (COR) for the duration of the Work of this Contract.

1.12 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant.

1.13 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Consultant.

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

.3 Consultant may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

.1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Consultant.

1.15 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Consultant.

1.16 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

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 humankind; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 SUBMITTALS

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

.2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.4 Environmental protection plan include:

.1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.

.2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.

.3 Names and qualifications of persons responsible for training site personnel.

.4 Descriptions of environmental protection personnel training program.

.5 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.6 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.7 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.

.8 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.9 Waste water management plan that identifies methods and procedures for management and/or 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.

.10 Include an equipment access plan.

1.3 FIRE PREVENTION AND CONTROL

.1 Carry fire extinguisher for use on each machine and at locations as required in the event of fire. Basic fire fighting equipment recommended includes three shovels, two pulaskis, and two five gallon backpack pumps) shall be maintained at the construction site at a location known and easily accessible to Contractors' staff. Contractor's staff shall receive basic training in early response to wildfire events during the "environmental briefing".

.2 A water truck may be necessary and will depend on the timing of the contract (e.g. - not required during winter or snow covered conditions).

.3 Construction equipment shall be operated in a manner and with all original manufacturer's safety devices to prevent ignition of flammable materials in the area.

.4 Care shall be taken while smoking on the construction site to ensure that the accidental ignition of any flammable material is prevented.

.5 In case of fire, the Contractor or worker shall take immediate action to extinguish the fire provided it is safe to do so. The ESO and the Departmental Representative shall be notified of any fire immediately. If not available, Banff Dispatch shall be contacted at (403) 762-4506.

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

1.4 DISPOSAL OF WASTES

.1 All garbage must be stored and handled in conformance with the National Parks Garbage Regulations.

.2 All surplus and waste materials shall be removed from the job site to approved sites outside of the National Parks. Disposal of all wastes shall be in compliance with the Environmental Contaminants Act and applicable provincial regulations while observing the Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments.

.3 Contractor shall remove all demolition, construction, and trade waste from the site and dispose of materials at designated site on a regular basis or when directed by Departmental Representative. All users and vehicles must report to the transfer scales prior to the disposal of any material. Various rate schedules apply for unsorted waste, scrap metal, asphalt shingles, appliances, and painted wood.

.4 No food, domestic garbage or hazardous wastes may be deposited in the trade waste site. Obtain bear proof garbage containers on-site for domestic garbage generated on-site by Contractor’s personnel.

.5 Dispose of all hazardous wastes in conformance with the Environmental Contaminants Act and applicable provincial regulations and Section 02 50 13 while observing the Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments.

.6 Maintain the site in a tidy condition, free from the accumulation of waste products, debris and litter.

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

.8 No separate payment will be made for waste disposal. Costs of this work shall be considered incidental to the contract.

.9 Remove all demolition, construction, and trade waste from the site and dispose outside of Parks land to a provincial approved landfill. Other salvaged or dispose materials to location as directed herewithin this document.

1.5 NATIONAL PARKS REGULATIONS

.1 The Contractor and all sub-contractors shall ensure that all work is performed in accordance with the ordinances, laws, rules and regulations set out in the Canada National Parks Act and Regulations.

.2 The Contractor and all sub-Contractors, each, shall obtain a business license from the Parks Canada Administration Office prior to commencement of the contract.

.3 Contractor and all sub-contractors shall comply with all laws and government regulations applicable to work under this contract.

.4 Contractor’s business and private vehicles are required to obtain a vehicle work pass from Parks Canada. These permits may be obtained free of charge at Parks Administration Office.

.5 Contractor to equip all service and supervisory vehicles with Emergency Spill Kit DOT-E-10102 or equivalent.

.6 Contractor is responsible to ensure all sub-contractors comply with the National Park Regulations.

1.6 CANADIAN ENVIRONMENTAL ASSESSMENT ACT

.1 Execution of the work is subject to the provisions within the Canadian Environmental Assessment Act Guidelines Order of 2003 and subsequent amendments.

.2 Failure to comply with or observe environmental protection measures as identified in these specifications may result in the work being suspended pending rectification of the problem.

1.7 WILDLIFE

.1 Avoid or terminate activities on-site that attract, disturb or harass wildlife and vacate the area and stay away from the immediate location if wildlife display aggressive behaviour or persistent intrusion.

.2 Notify the Departmental Representative and Parks Environmental Surveillance Officer (ESO) immediately of wildlife encounters on or around the site. Other wildlife encounters should be reported within 24 hours.

.3 During the Environmental Briefing all personnel shall be instructed by the ESO on procedures to follow in the event of wildlife appearance near or within the work site and any other wildlife concerns.

.4 Pets will not be permitted on site.

1.8 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Control emissions from equipment and plant to local authorities' emission requirements.

.3 The Contractor shall prevent any deleterious and objectionable materials from entering streams, rivers, wetlands, water bodies or watercourses that would result in damage to aquatic and riparian habitat. Hazardous or toxic products shall be stored no closer than 100 metres from any watercourse.

.4 A Spill Response Plan will be prepared as part of the EPP and shall detail the containment and storage, security, handling, use and disposal of empty containers, surplus product or waste generated in the application of these products, to the satisfaction of the Departmental Representative and the ESO and in accordance with all applicable federal and provincial legislation. The EPP shall include a list of products and materials to be used or brought to the construction site that are considered or defined as hazardous or toxic to the environment.

.5 Equip all service and supervisory vehicles with Emergency Spill Kit DOT-E-10102 or equivalent.

.6 The containment, storage, security, handling, use, unique spill response requirements and disposal of empty containers, surplus product or waste generated in the use of any hazardous or toxic products shall be in accordance with all applicable federal and provincial legislation. Hazardous products shall be stored no closer than 100 metres from any watercourse.

.7 Timely and effective action shall be taken to stop, contain and clean-up all spills as long as the site is safe to enter. The Departmental Representative and the ESO shall be notified immediately of any spill. If not available, Banff Dispatch will be contacted at (403) 762-4506. Spill response cards will be distributed during the initial Environmental Briefing with basic instructions and phone numbers.

.8 In the event of a major spill, all other work shall be stopped and all personnel devoted to spill containment and clean-up.

.1 The costs involved in a spill incident (the control, clean up, disposal of contaminants and site remediation to pre-spill conditions), shall be the responsibility of the Contractor. The site will be inspected to ensure completion to the expected standard and to the satisfaction of the Departmental Representative and ESO.

1.9 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.

.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

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 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 and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION 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 except as follows:

.1 Williams Engineering will be performing roofing inspections on behalf of the Departmental Representative and paid for by the Departmental Representative.

.2 RSR will be commissioning the HVAC Equipment on behalf of the Departmental Representative and paid for by the Departmental Representative.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative, pay costs for retesting and reinspection.

1.3 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.

1.4 PROCEDURES

.1 Notify appropriate agency 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.

1.5 REJECTED WORK

.1 Refer to Departmental Representative/Contractor Contract.

.2 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.

.3 Make good other Contractor's work damaged by such removals or replacements promptly to the satisfaction of the Departmental Representative.

.4 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental 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 Departmental Representative.

1.6 REPORTS

.1 Submit electronic copies of inspection and test reports to Departmental Representative.

.2 Provide copies to Trade Contractor of work being inspected or tested and manufacturer or fabricator of material being inspected or tested.

1.7 MILL TESTS

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

1.8 EQUIPMENT AND SYSTEMS

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.3 DEWATERING

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

1.4 WATER SUPPLY

.1 Provide continuous supply of potable water for construction use.

1.5 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted.

.3 Contractor and Department Representative shall determine the level of propane in Department Representative's propane tank(s) prior to start construction. Contractor is fully responsible for the propane tank(s) and provide fuel at their cost. At the Contractor’s discretion, the Contractor shall remove and dispose of the propane tanks as part of the Work.

.4 Provide temporary heat and ventilation in enclosed areas as required to:

- .1 Facilitate progress of Work.
- .2 Protect Work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.

.5 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.

.6 Ventilating:

- .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.7 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.

.8 On completion of Work for which permanent heating system is used, replace filters.

.9 Pay costs for maintaining temporary heat, when using permanent heating system.

.10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

.11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 TEMPORARY POWER AND LIGHT

.1 Provide and pay for temporary power and lighting as required.

.2 Pay costs for installation, maintenance, and removal.

.3 Provide and maintain temporary lighting while on site. Ensure level of illumination on all floors and stairs is not less than 162 lx.

1.7 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for temporary cell phone and data device lines necessary for own use.

1.8 FIRE PROTECTION

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

.2 Burning rubbish and construction waste materials is not permitted on site.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)

.1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-0121-08, Douglas Fir Plywood.

.3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.

.4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

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

.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 SUBMITTALS

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

1.3 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 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

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

.5 Remove from site all such work after use.

1.4 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding, ramps, ladders, swing staging, and platforms.

1.5 HOISTING

.1 Provide, operate and maintain hoists cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

.2 Hoists cranes to be operated by qualified operator.

1.6 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.

.3 Store products in building on site, confirm location and size of storage with Departmental Representative.

1.7 CONSTRUCTION PARKING

.1 Limited parking will be permitted on site provided it does not disrupt performance of Work.

.2 Provide and maintain adequate access to project site for authorized personnel.

.3 Follow vehicle parking limitations and permit requirements when within the park.

.4 Personal vehicles shall not be parked on any natural or undisturbed areas. Parking will be confined to parking lots and roads or as approved by the Departmental Representative.

1.8 SECURITY

.1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

.2 Provide fencing and additional security as deemed necessary.

1.9 OFFICES

.1 Provide optional office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.

.2 Provide marked and fully stocked first-aid case in a readily available location.

.3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

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

1.11 SANITARY FACILITIES

.1 Provide portable 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.

1.12 CONSTRUCTION SIGNAGE

.1 No signs or advertisements, other than warning signs, are permitted on site.

.2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.

.3 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 Departmental Representative.

.4 Company signage is allowed on trailers or vehicles, not elsewhere on site.

1.13 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.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 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

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

.9 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.10 Snow Removal. Contractor is responsible for snow clearing within their work site including parking lots, sidewalks, etc as shown in the drawings 'Limit of Work'.

1.14 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material not in construction facilities.

.5 Vacuum out all roof drains and locations where debris may have gathered during construction daily.

1.15 FIRE PROTECTION FACILITIES

.1 Provide fire extinguisher and other equipment on site and maintain emergency vehicle access at all times.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International)

.1 CSA-O121-08 (R2013), Douglas Fir Plywood.

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.3 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations and open edges of floors and roofs.

.2 Provide as required by governing authorities.

1.4 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs where required to keep partially demolished materials within existing buildings, and not allowing wind-blown debris to depart and be dispersed in an un-authorized manner.

1.5 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.6 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.7 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.9 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.10 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Within text of each specifications section, reference may be made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 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.

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review project 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.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, 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 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.6 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

.7 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.

1.6 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.

.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.

1.7 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by licensed or qualified 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.

1.8 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.

1.9 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.

1.10 REMEDIAL WORK

.1 Refer to Section 01 73 00 - Execution Requirements.

.2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 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.

1.12 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.

1.13 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.

1.14 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

1.15 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities including Parks owned utilities, with minimum of disturbance to Work, and/or building occupants. Make arrangements with Departmental Representative.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 EXISTING SERVICES

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

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

1.2 LOCATION OF EQUIPMENT AND FIXTURES

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

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

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

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

1.3 SUBSURFACE CONDITIONS

.1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Submit written request in advance of cutting or alteration which affects:

- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Departmental Representative or separate contractor.

.3 Include in request:

- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Departmental Representative or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 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 are to be exposed by uncovering work; maintain excavations free of water.

1.4 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 Remove samples of installed Work for testing.

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

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

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

.9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.10 Restore work with new products in accordance with requirements of Contract Documents.

.11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.

.13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions "C", In Effect as Of: May 14, 2004.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Departmental Representative.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of outside of National Park. Do not burn waste materials on site.

.3 Clear snow and ice from access to building including parking lot and sidewalks, bank/pile snow in designated areas only as directed by Departmental Representative.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

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

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.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.

1.3 FINAL CLEANING

.1 Clean work prior to final review by Departmental Representative.

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

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

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

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

.6 Remove waste products and debris including that was caused by Departmental Representative.

.7 Remove waste materials from site at regularly scheduled times or dispose of outside of National Park. Do not burn waste materials on site.

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

.9 Remove dirt and other disfiguration from exterior surfaces.

.10 Clean and sweep roofs, gutters, areaways, and sunken wells.

.11 Sweep and wash clean paved areas.

.12 Clean equipment and fixtures to sanitary condition.

.13 Clean mechanical equipment including replacement of filters.

.14 Clean roofs, downspouts, and drainage systems.

.15 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.16 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

.1 Recycle metals and any other items that are accepted at recycling facility. Provide way bills to Departmental Representative.

.2 Prior to start of Work conduct meeting with Departmental Representative to review and discuss Waste Management Plan and Goals and prepare a waste management plan.

.3 Waste Management Goal: as much as possible of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.

1.2 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation and demolition 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 Separate Condition: refers to waste sorted into individual types.

.7 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to recycled and salvaged are to be removed from site to recycling facility without storing on site. Materials to be recycled on site are to be placed in final location with minimum of rehandling. Stockpiles of concrete in areas other than final buried location will not be permitted.

.2 Unless specified otherwise, materials for removal become Contractor’s property.

.3 Separate recyclable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility. Transport and deliver recyclable items to recycling facilities.

.4 Protect surface drainage, mechanical and electrical from damage and blockage.

.5 Separate and store materials produced during dismantling of structures in designated areas.

.6 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 recommended.

.2 Remove co-mingled materials to off-site processing facility for separation.

1.4 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers.

.3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

1.5 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

1.6 SCHEDULING

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 APPLICATION

.1 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 On-site sale of recyclable materials is not permitted.

3.4 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1 Schedule E - Government Chief Responsibility for the Environment:

Alberta	Alberta Environmental Protection Petroleum Plaza, South Tower 9915 - 108th Street Edmonton AB T5K 2G8	780-427-2739	
	Alberta Special Waste Management Corporation Pacific Plaza, Suite 610 10909 Jasper Avenue NW Edmonton AB T5J 3L9	780-422-5029	780-428-9627

END OF SECTION

Part 1 General

1.1 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and Subcontractors: 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 that corrections have been made.

.2 Request Departmental Representative Inspection.

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

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

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

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

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

.4 Operation of systems have been demonstrated to Departmental Representative's personnel.

.5 Work is complete and ready for final inspection.

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

1.2 CLEANING

.1 In accordance with Section 01 74 11 - Cleaning.

.2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.3 Copy will be returned after final inspection, with Departmental Representative's comments.

.4 Revise content of documents as required prior to final submittal.

.5 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative four final hard copies and two discs in pdf format of operating and maintenance manuals in English.

.6 Furnish evidence, if requested, for type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

1.2 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product.

.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 marked up red-line drawings to the Departmental Representative for them to update the drawings, 1:1 scaled CAD files in dwg format on CD.

1.3 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

.1 Date of submission; names.

.2 Addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

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

1.4 AS-BUILTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

.5 Reviewed shop drawings, product data, and samples.

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

1.5 RECORDING ACTUAL SITE CONDITIONS

.1 Record information in red on set of blue line opaque drawings, and in copy of Project Manual, 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: 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: 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.

1.6 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 co-ordination 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 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.8 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 site, location as directed; place and store.

.4 Receive and catalogue 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.

1.9 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 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.

1.10 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

1.11 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.

.3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.

.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.

.6 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:

.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 applicable item of work.

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

.5 Co-execute submittals when required.

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

.7 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct10 month warranty inspection, measured from time of acceptance, by Departmental Representative.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and commissioned systems such as fire protection, alarm systems, and lightning protection systems.

.3 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.4 Contractor's plans for attendance at 10 month post-construction warranty inspections.

.5 Procedure and status of tagging of equipment covered by extended warranties.

.6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.10 Respond in a timely manner to oral or written notification of required construction warranty repair work.

.11 Written verification will follow oral instructions. Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.12 PRE-WARRANTY CONFERENCE

.1 Meet with Departmental Representative, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Departmental Representative.

.2 Departmental Representative will establish communication procedures for:

.1 Notification of construction warranty defects.
.2 Determine priorities for type of defect.
.3 Determine reasonable time for response.

.3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.13 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Leave date of acceptance until project is accepted for occupancy.

.4 Indicate following information on tag:

.1 Type of product/material.
.2 Model number.
.3 Serial number.
.4 Contract number.
.5 Warranty period.
.6 Inspector's signature.
.7 Construction Contractor.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Revised June 3, 2016

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 Acronyms:

.1 BMM - Building Management Manual.

.2 Cx - Commissioning.

.3 EMCS - Energy Monitoring and Control Systems.

.4 O&M - Operation and Maintenance.

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the BMM.

.3 Effectively train O&M staff.

.2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

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

.2 Cx is conducted in concert with activities performed during project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.3 Departmental Representative will issue Interim Acceptance Certificate when:

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

.2 Equipment, components, systems and integrated systems have been fully commissioned, functional and operational as per Construction Documentation within the context of the owner requirements.

.3 Final O&M and Training Manual receive, review and approve by Departmental Representative for suitability.

.4 Completion of Training session to all Operational and Maintenance staffs.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

.1 Before Construction:

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

.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 Work with Departmental Representative to create a commissioning schedule.

.2 Ensure installation of related components, equipment, sub-systems and systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Department Representative.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

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

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

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

1.6 CONFLICTS

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

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

1.7 COMMISSIONING DOCUMENTATION

.1 Commissioning Checksheets will be provided by the Departmental Representative and completed by the Contractor.

.2 These sheets will be reviewed for completeness by the Departmental Representative during Construction Commissioning Reviews.

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

1.8 COMMISSIONING SCHEDULE

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

.1 Approval of Cx reports.

.2 Verification of reported results.

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

.4 Training.

1.9 COMMISSIONING MEETINGS

.1 Attend Cx meetings following project meetings. Meetings will be organized by General Contractor. Agenda and Minutes will be recorded by the Departmental Representative.

.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 of each phase call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Departmental Representative who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.10 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.

1.11 WITNESSING OF STARTING AND TESTING

.1 Provide 7 days notice prior to commencement.

.2 Departmental Representative to witness of start-up and testing as deemed necessary.

1.12 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Arrange for Departmental Representative to witness tests.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.

.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.

1.13 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 approval from Departmental Representative after distinct phases have been completed and before commencing next phase.

.4 Document require tests on PV forms provided by Departmental Representative.

1.14 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Departmental Representative.

.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 repeat start-up at any time.

1.15 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 Departmental Representative 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.

1.16 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.

1.17 START OF COMMISSIONING

.1 Notify Independent Commissioning Authority at least 21 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.18 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual or accepted 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.

1.19 WITNESSING COMMISSIONING

.1 Departmental Representative to witness activities and verify results.

1.20 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 Departmental Representative within 5 days of test and with Cx report.

1.21 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, and seasonal sensitive equipment and systems in these areas.

1.22 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 approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.23 EXTENT OF VERIFICATION

.1 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.2 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.3 Perform additional commissioning until results are acceptable to Departmental Representative.

1.24 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.

1.25 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.

.2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

1.26 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 accepted by Departmental Representative.

1.27 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.

1.28 TRAINING

.1 As noted in specification in applicable sections.

1.29 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.30 OCCUPANCY

.1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.31 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.

1.32 OWNER'S PERFORMANCE TESTING

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-1

Design - AHU-1

	Verification	Response	Notes	By	Date/Time
1	Spec Service	South Offices			6/1/16 16:36
2	Spec-Manufacturer	Engineered Air			6/1/16 16:36
3	Spec Model No	DJS-100/0			6/1/16 16:36
4	Spec. Supply Air Flow	4229 l/s			6/1/16 16:36
5	Spec - Supply Fan ESP	573 Pa			6/1/16 16:36
6	Spec Supply Fan Motor Size	10 hp			6/1/16 16:36
7	Spec Min Outdoor Air				
8	Spec Return Fan Air Flow	3585 l/s			6/1/16 16:36
9	Spec Return Fan ESP	282 Pa			6/1/16 16:36
10	Spec Return Fan Motor Size	5 hp			6/1/16 16:36
11	Spec - Heating Input/Output	190/173.9 kW			11/9/16 11:16
12	Spec - Unit with Economizer	Yes			6/1/16 16:36
13	Spec-Final Filter Efficiency	Merv 8			6/1/16 16:36
14	Spec - V/ph/hz	208v/3ph/60hz			6/1/16 16:36

Operational Performance Test - AHU-1

	Verification	Response	Notes	By	Date/Time
1	Fan Rotation Correct				
2	Acceptable noise and vibration				
3	All dampers stroke fully without binding and spans calibrated				
4	Unit maintains acceptalbe supply air temperature heating				
5	Air Balance Complete				
6	Start-up Report Complete				

General - AHU-1

	Verification	Response	Notes	By	Date/Time
1	Serial #				
2	Location				
3	Service				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-1

Installation - AHU-1

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model No.				
3	SUPPLY FAN-Air Flow				
4	SUPPLY FAN-E.S.P.				
5	SUPPLY FAN-Motor				
6	Supply Fan rpm				
7	Electrical				
8	Min Outdoor Air				
9	RETURN FAN-Air Flow				
10	RETURN FAN-E.S.P. (kPa)				
11	RETURN FAN-Motor				
12	Return Fan rpm				
13	Heating Airflow				
14	HEATING COIL-E/L Air (C)				
15	Heat Input/Output				
16	Temp Rise				
17	Final Filter Efficiency				
18	Unit Complete With Economizer				
19	Preheat Coil Airflow				
20	Preheat Coil Air Pressure Drop				
21	Heating Medium				
22	Ent/Leaving Fluid temp				
23	Ent/Leaving Air Temp				
24	Air PD				
25	Fluid PD				
26	Total capacity				
27	Return/Exhaust Filter Efficiency				

Pre-Functional Checks - AHU-1

	Verification	Response	Notes	By	Date/Time
1	Installation According to Shop Drawings				
2	Unit Assembled Properly				
3	All Components Accessible				
4	All Sections Air Sealed				
5	Starters and Disconnects Complete & Labelled				
6	Unit Insulation Complete				
7	Unit Vibration Isolation Complete				
8	Duct Connections Done Properly				
9	Unit Cleaned				
10	Test Holes for Pressure and Temp.				
11	Correct Air Filters Installed				
12	Filters Installed in Correct Direction				
13	Condensate line to drain with P-trap				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-1

Verification		Response	Notes	By	Date/Time
1	CONTROLS - Component Verifications are Complete				
2	CONTROLS - Calibration Complete				
3	CONTROLS - Manual Overrides and Jumpers Removed				
4	SYSTEM ENABLE - Economizer Control Functions O/A Below R/A Temp				
5	Fan rotation correct				
6	Belts tighten properly no signs of wear				
7	SIGN-OFF - All Control Sequences Operate as Per Spec.				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-2

Design - AHU-2

	Verification	Response	Notes	By	Date/Time
1	Spec Service	West Offices			6/1/16 16:47
2	Spec-Manufacturer	Engineered Air			6/1/16 16:36
3	Spec Model No	DJS-40/0			6/1/16 16:47
4	Spec. Supply Air Flow	2360 l/s			6/1/16 16:47
5	Spec - Supply Fan ESP	344 kPa			6/1/16 16:47
6	Spec Supply Fan Motor Size	5 hp			6/1/16 16:47
7	Spec Min Outdoor Air				
8	Spec Return Fan Air Flow	1865 l/s			6/1/16 16:47
9	Spec Return Fan ESP	282 Pa			6/1/16 16:36
10	Spec Return Fan Motor Size	5 hp			6/1/16 16:36
11	Spec - Heating Input/Output	102.5/82 kW			6/1/16 16:47
12	Spec - Unit with Economizer	Yes			6/1/16 16:36
13	Spec-Final Filter Efficiency	Merv 8			6/1/16 16:36
14	Spec - V/ph/hz	208v/3ph/60hz			6/1/16 16:36

Operational Performance Test - AHU-2

	Verification	Response	Notes	By	Date/Time
1	Fan Rotation Correct				
2	Acceptable noise and vibration				
3	All dampers stroke fully without binding and spans calibrated				
4	Unit maintains acceptalbe supply air temperature heating				
5	Air Balance Complete				
6	Start-up Report Complete				

General - AHU-2

	Verification	Response	Notes	By	Date/Time
1	Serial #				
2	Location				
3	Service				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-2

Installation - AHU-2

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model No.				
3	SUPPLY FAN-Air Flow				
4	SUPPLY FAN-E.S.P.				
5	SUPPLY FAN-Motor				
6	Supply Fan rpm				
7	Electrical				
8	Min Outdoor Air				
9	RETURN FAN-Air Flow				
10	RETURN FAN-E.S.P. (kPa)				
11	RETURN FAN-Motor				
12	Return Fan rpm				
13	Heating Airflow				
14	HEATING COIL-E/L Air (C)				
15	Heat Input/Output				
16	Temp Rise				
17	Final Filter Efficiency				
18	Unit Complete With Economizer				
19	Preheat Coil Airflow				
20	Preheat Coil Air Pressure Drop				
21	Heating Medium				
22	Ent/Leaving Fluid temp				
23	Ent/Leaving Air Temp				
24	Air PD				
25	Fluid PD				
26	Total capacity				
27	Return/Exhaust Filter Efficiency				

Pre-Functional Checks - AHU-2

	Verification	Response	Notes	By	Date/Time
1	Installation According to Shop Drawings				
2	Unit Assembled Properly				
3	All Components Accessible				
4	All Sections Air Sealed				
5	Starters and Disconnects Complete & Labelled				
6	Unit Insulation Complete				
7	Unit Vibration Isolation Complete				
8	Duct Connections Done Properly				
9	Unit Cleaned				
10	Test Holes for Pressure and Temp.				
11	Correct Air Filters Installed				
12	Filters Installed in Correct Direction				
13	Condensate line to drain with P-trap				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-2

Verification		Response	Notes	By	Date/Time
1	CONTROLS - Component Verifications are Complete				
2	CONTROLS - Calibration Complete				
3	CONTROLS - Manual Overrides and Jumpers Removed				
4	SYSTEM ENABLE - Economizer Control Functions O/A Below R/A Temp				
5	Fan rotation correct				
6	Belts tighten properly no signs of wear				
7	SIGN-OFF - All Control Sequences Operate as Per Spec.				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-3

Design - AHU-3

	Verification	Response	Notes	By	Date/Time
1	Spec Service	Offices, Storage			6/1/16 16:50
2	Spec-Manufacturer	Engineered Air			6/1/16 16:36
3	Spec Model No	DJS-60/0			6/1/16 16:50
4	Spec. Supply Air Flow	2600 l/s			6/1/16 16:50
5	Spec - Supply Fan ESP	187 Pa			6/1/16 16:50
6	Spec Supply Fan Motor Size	5 hp			6/1/16 16:47
7	Spec Min Outdoor Air				
8	Spec Return Fan Air Flow	1614 l/s			6/1/16 16:50
9	Spec Return Fan ESP	187 Pa			6/1/16 16:50
10	Spec Return Fan Motor Size	2hp			6/1/16 16:50
11	Spec - Heating Input/Output	131.2/105.4 kW			6/1/16 16:50
12	Spec - Unit with Economizer	Yes			6/1/16 16:36
13	Spec-Final Filter Efficiency	Merv 8			6/1/16 16:36
14	Spec - V/ph/hz	208v/3ph/60hz			6/1/16 16:36

Operational Performance Test - AHU-3

	Verification	Response	Notes	By	Date/Time
1	Fan Rotation Correct				
2	Acceptable noise and vibration				
3	All dampers stroke fully without binding and spans calibrated				
4	Unit maintains acceptalbe supply air temperature heating				
5	Air Balance Complete				
6	Start-up Report Complete				

General - AHU-3

	Verification	Response	Notes	By	Date/Time
1	Serial #				
2	Location				
3	Service				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-3

Installation - AHU-3

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model No.				
3	SUPPLY FAN-Air Flow				
4	SUPPLY FAN-E.S.P.				
5	SUPPLY FAN-Motor				
6	Supply Fan rpm				
7	Electrical				
8	Min Outdoor Air				
9	RETURN FAN-Air Flow				
10	RETURN FAN-E.S.P. (kPa)				
11	RETURN FAN-Motor				
12	Return Fan rpm				
13	Heating Airflow				
14	HEATING COIL-E/L Air (C)				
15	Heat Input/Output				
16	Temp Rise				
17	Final Filter Efficiency				
18	Unit Complete With Economizer				
19	Preheat Coil Airflow				
20	Preheat Coil Air Pressure Drop				
21	Heating Medium				
22	Ent/Leaving Fluid temp				
23	Ent/Leaving Air Temp				
24	Air PD				
25	Fluid PD				
26	Total capacity				
27	Return/Exhaust Filter Efficiency				

Pre-Functional Checks - AHU-3

	Verification	Response	Notes	By	Date/Time
1	Installation According to Shop Drawings				
2	Unit Assembled Properly				
3	All Components Accessible				
4	All Sections Air Sealed				
5	Starters and Disconnects Complete & Labelled				
6	Unit Insulation Complete				
7	Unit Vibration Isolation Complete				
8	Duct Connections Done Properly				
9	Unit Cleaned				
10	Test Holes for Pressure and Temp.				
11	Correct Air Filters Installed				
12	Filters Installed in Correct Direction				
13	Condensate line to drain with P-trap				

Air Handling Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: AHU-3

Verification		Response	Notes	By	Date/Time
1	CONTROLS - Component Verifications are Complete				
2	CONTROLS - Calibration Complete				
3	CONTROLS - Manual Overrides and Jumpers Removed				
4	SYSTEM ENABLE - Economizer Control Functions O/A Below R/A Temp				
5	Fan rotation correct				
6	Belts tighten properly no signs of wear				
7	SIGN-OFF - All Control Sequences Operate as Per Spec.				

Boiler

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: B-1

Design - B-1

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Burnham			6/2/16 16:31
2	Spec-Model #	MPC 9			11/9/16 11:35
3	Spec-Type	Multi-Pass Cast Iron			6/2/16 16:24
4	Spec-Input	486.1 kW			11/9/16 11:35
5	Spec-Heated Output	377.6 kW			11/9/16 11:35
6	Spec - Electrical	120v/1ph/60hz			6/2/16 16:24
7	Spec-Service/Location	Trades Boiler Room			11/9/16 11:35
8	Spec-Fuel Type	Natural Gas			6/2/16 16:24

General - B-1

	Verification	Response	Notes	By	Date/Time
1	Tag #/BAS Mnemonic				
2	System				

Installation - B-1

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Location				
3	Series				
4	Model #				
5	Media				
6	Type				
7	Input	kW BTUH			
8	Output	kW BTUH			
9	Efficiency				
10	Flow				
11	P.D				
12	Electrical				
13	Serial #				
14	Service				
15	Draft Type				
16	Fuel Type				
17	Entering/Leaving Temp.				
18	Working Fluid				

Boiler

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: B-1

Pre-Functional Checks - B-1

	Verification	Response	Notes	By	Date/Time
1	Pipe Fitting and accessories complete				
2	Press. Relief Valve				
3	Size/Pressure Setting				
4	Hydronic system flushing complete and strainers cleaned				
5	Flow Switch Installed and interlocked				
6	Clearance Around Boiler Adequate				
7	Combustion Air Available				
8	Local Disconnect				
9	No visible leaks				
10	Blower operates properly				
11	Gas Train Checked for leaks				
12	Gas Piping tested				
13	Gas train safety devices operational				
14	Boiler Room Condition				
15	According to Shop Drawings				
16	Drip leg provided in gas main				
17	No Damage to Flues, Chimneys & Boiler Jacket				
18	Make-up water system properly set and operating				
19	Boiler Safety Installed & Operational				
20	Pressure & Temperature Gauges Installed				
21	Control system interlocks connected and functional				
22	Isolating/Balancing Valves Installed				
23	All Labels are Visible				
24	Flue properly sloped and condensate drained as applicable				
25	System Filled with Fluid & Air Vented				
26	Readings from BAS match readings at system				

	Verification	Response	Notes	By	Date/Time
1	High Limit Setting/Calibr.				
2	Boiler-Pump Interlock Confirmed				
3	Manufacturers Start up completed				
4	Boiler Rated for Altitude				

Boiler

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: B-2

Design - B-2

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Burnham			6/2/16 16:31
2	Spec-Model #	MPC 9			11/9/16 11:35
3	Spec-Type	Multi-Pass Cast Iron			6/2/16 16:24
4	Spec-Input	486.1 kW			11/9/16 11:35
5	Spec-Heated Output	377.6 kW			11/9/16 11:35
6	Spec - Electrical	120v/1ph/60hz			6/2/16 16:24
7	Spec-Service/Location	Trades Boiler Room			11/9/16 11:35
8	Spec-Fuel Type	Natural Gas			6/2/16 16:24

General - B-2

	Verification	Response	Notes	By	Date/Time
1	Tag #/BAS Mnemonic				
2	System				

Installation - B-2

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Location				
3	Series				
4	Model #				
5	Media				
6	Type				
7	Input	kW BTUH			
8	Output	kW BTUH			
9	Efficiency				
10	Flow				
11	P.D				
12	Electrical				
13	Serial #				
14	Service				
15	Draft Type				
16	Fuel Type				
17	Entering/Leaving Temp.				
18	Working Fluid				

Boiler

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: B-2

Pre-Functional Checks - B-2

	Verification	Response	Notes	By	Date/Time
1	Pipe Fitting and accessories complete				
2	Press. Relief Valve				
3	Size/Pressure Setting				
4	Hydronic system flushing complete and strainers cleaned				
5	Flow Switch Installed and interlocked				
6	Clearance Around Boiler Adequate				
7	Combustion Air Available				
8	Local Disconnect				
9	No visible leaks				
10	Blower operates properly				
11	Gas Train Checked for leaks				
12	Gas Piping tested				
13	Gas train safety devices operational				
14	Boiler Room Condition				
15	According to Shop Drawings				
16	Drip leg provided in gas main				
17	No Damage to Flues, Chimneys & Boiler Jacket				
18	Make-up water system properly set and operating				
19	Boiler Safety Installed & Operational				
20	Pressure & Temperature Gauges Installed				
21	Control system interlocks connected and functional				
22	Isolating/Balancing Valves Installed				
23	All Labels are Visible				
24	Flue properly sloped and condensate drained as applicable				
25	System Filled with Fluid & Air Vented				
26	Readings from BAS match readings at system				

	Verification	Response	Notes	By	Date/Time
1	High Limit Setting/Calibr.				
2	Boiler-Pump Interlock Confirmed				
3	Manufacturers Start up completed				
4	Boiler Rated for Altitude				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH1

Design - RH1

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	564 L/sec			6/2/16 16:40
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH1

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH1

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH1

Pre-Functional Checks - RH1

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH10

Design - RH10

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	1139 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH10

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH10

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH10

Pre-Functional Checks - RH10

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH11

Design - RH11

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	224 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH11

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH11

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH11

Pre-Functional Checks - RH11

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH12

Design - RH12

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	New			6/2/16 16:49
3	Spec Model	ENG9x12x1/6			11/9/16 11:40
4	Spec-Flow Rate-AIR	228 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH12

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH12

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH12

Pre-Functional Checks - RH12

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH2

Design - RH2

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	705 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH2

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH2

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH2

Pre-Functional Checks - RH2

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH3

Design - RH3

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	New			6/2/16 16:49
3	Spec Model	ENG12x24x1/8			11/9/16 11:41
4	Spec-Flow Rate-AIR	620 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH3

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH3

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH3

Pre-Functional Checks - RH3

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH4

Design - RH4

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	552 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH4

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH4

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH4

Pre-Functional Checks - RH4

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH5

Design - RH5

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	728 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH5

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH5

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH5

Pre-Functional Checks - RH5

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH6

Design - RH6

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	New			6/2/16 16:49
3	Spec Model	ENG9x12x1/6			11/9/16 11:42
4	Spec-Flow Rate-AIR	162 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH6

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH6

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH6

Pre-Functional Checks - RH6

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH7

Design - RH7

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	752 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH7

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH7

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH7

Pre-Functional Checks - RH7

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH-8

Design - RH-8

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	New			6/2/16 16:49
3	Spec Model	Eng9x12x1/6			11/9/16 11:39
4	Spec-Flow Rate-AIR	230 L/sec			11/9/16 11:39
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH-8

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH-8

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH-8

Pre-Functional Checks - RH-8

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH9

Design - RH9

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 16:40
2	Spec-Type/Mark	Existing			6/2/16 16:40
3	Spec Model	Existing			6/2/16 16:40
4	Spec-Flow Rate-AIR	752 L/sec			6/2/16 16:49
5	Spec-EAT (db)	12.8 deg C			6/2/16 16:40
6	Spec-LAT (db)	23.9 deg C			6/2/16 16:40
7	Spec-AIR Pressure Differential	45 Pa Pa			6/2/16 16:40
8	Spec-Flow Rate-WATER	0.13 L/sec			6/2/16 16:40
9	Spec-EWT	82.2 deg C			6/2/16 16:40
10	Spec-LWT	71.1 deg C			6/2/16 16:40
11	Spec-WATER Pressure Differential	2.2 kPa			6/2/16 16:40

General - RH9

	Verification	Response	Notes	By	Date/Time
1	System Name				
2	Piping installed as per detail				
3	Medium				
4	Location				
5	Duty				
6	BMS tag/Mnemonic				

Installation - RH9

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Type/Mark				
4	Capacity	kw			
5	Flow rate-AIR	L/sec			
6	Air Velocity	m/sec			
7	EAT (db)	deg C			
8	LAT (db)	deg C			
9	AIR Pressure Differential	Pa			
10	Flow rate-WATER	L/sec			
11	Water Velocity	m/sec			
12	EWT	deg C			
13	LWT	deg C			
14	Water Pressure Differential	kPa			
15	Rows/Fins				

Coil - Water

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RH9

Pre-Functional Checks - RH9

	Verification	Response	Notes	By	Date/Time
1	Isolation Valves installed				
2	Air vents to be tested				
3	Fins require combing/straightening				
4	Duct requires modifications				
5	Coil access suitable for cleaning				
6	Control Valve piped correctly				
7	Coil/Piping flushed and cleaned				
8	Condensate p-trap installed				
9	Condensate piped to drain				
10	Coil Piping insulated and labelled				
11	Coil piping unions installed and accessible				
12	Balancing Valves Installed & Accessible				
13	Control Valve Installed & Accessible				
14	Temperature/Pressure Gauges Installed				
15	Coil has Dead Leg and Drain valves				
16	Freeze Stat operates properly				
17	Access Doors Installed				
18	Space provided for Coil Removal				
19	Labels Visible, Valves Tagged				

	Verification	Response	Notes	By	Date/Time
1	Air systems balancing are complete and approved				
2	No Air Bypass Around Coil				
3	Coil Balanced, Valves Marked				
4	Control Valve Operation				
5	Reheat heats air to expected temperature rise				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-1

Design - EF-1

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	GB-220-7			6/2/16 16:59
3	Spec-Service & Location	Basement Storage/Warden Roof			6/2/16 16:59
4	Spec-Air Flow	2360 l/s			6/2/16 16:59
5	Spec-S.P.	93 Pa			6/2/16 16:59
6	Spec-Motor (Hp)	3/4			6/2/16 16:59
7	Spec-RPM	751			6/2/16 16:59
8	Spec-Sones	65 dBA			6/3/16 8:51
9	Spec-Electrical	208/3ph/60hz			6/2/16 16:59

General - EF-1

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-1

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-1

Pre-Functional Checks - EF-1

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-10

Design - EF-10

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-090-VG			6/3/16 8:51
3	Spec-Service & Location	Trades Corridor/Trades Roof			6/3/16 8:53
4	Spec-Air Flow	283 l/s			6/3/16 8:53
5	Spec-S.P.	31 Pa			6/3/16 8:53
6	Spec-Motor (Hp)	1/10			6/3/16 8:51
7	Spec-RPM	1387			6/3/16 8:53
8	Spec-Sones	51 dBA			6/3/16 8:53
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-10

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-10

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-10

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-10

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-10A

Design - EF-10A

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-090-VG			6/3/16 8:51
3	Spec-Service & Location	Tech Serv Corr/Tech Serv Roof			6/3/16 8:51
4	Spec-Air Flow	142 l/s			6/3/16 8:51
5	Spec-S.P.	62 Pa			6/3/16 8:51
6	Spec-Motor (Hp)	1/10			6/3/16 8:51
7	Spec-RPM	1124			6/3/16 8:51
8	Spec-Sones	47 dBA			6/3/16 8:51
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-10A

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-10A

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-10A

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-10A

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-10B

Design - EF-10B

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-090-VG			6/3/16 8:51
3	Spec-Service & Location	Tech Serv Corr/Tech Serv Roof			6/3/16 8:51
4	Spec-Air Flow	142 l/s			6/3/16 8:51
5	Spec-S.P.	62 Pa			6/3/16 8:51
6	Spec-Motor (Hp)	1/10			6/3/16 8:51
7	Spec-RPM	1124			6/3/16 8:51
8	Spec-Sones	47 dBA			6/3/16 8:51
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-10B

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-10B

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-10B

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-10B

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-11

Design - EF-11

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-090-VG			6/3/16 8:51
3	Spec-Service & Location	Washroom/Trades Roof			11/9/16 11:50
4	Spec-Air Flow	240 l/s			11/9/16 11:50
5	Spec-S.P.	62 Pa			11/9/16 11:50
6	Spec-Motor (Hp)	1/10			6/3/16 8:51
7	Spec-RPM	1396			11/9/16 11:50
8	Spec-Sones	51 dBA			6/3/16 8:53
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-11

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-11

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-11

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-11

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-12

Design - EF-12

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-116			11/9/16 11:53
3	Spec-Service & Location	Machine Shop/Garage Roof			11/9/16 11:53
4	Spec-Air Flow	1795 l/s			11/9/16 11:53
5	Spec-S.P.	125 Pa			11/9/16 11:53
6	Spec-Motor (Hp)	1 1/2			11/9/16 11:53
7	Spec-RPM	2024			11/9/16 11:53
8	Spec-Sones	72 db			11/9/16 11:53
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:53

General - EF-12

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-12

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-12

Pre-Functional Checks - EF-12

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-13

Design - EF-13

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-116			11/9/16 11:53
3	Spec-Service & Location	SW Bay (A/C) Garage Roof			11/9/16 11:55
4	Spec-Air Flow	1700 l/s			11/9/16 11:55
5	Spec-S.P.	83 Pa			11/9/16 11:55
6	Spec-Motor (Hp)	1			11/9/16 11:55
7	Spec-RPM	2024			11/9/16 11:53
8	Spec-Sones	70 db			11/9/16 11:55
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:53

General - EF-13

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-13

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-13

Pre-Functional Checks - EF-13

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-14

Design - EF-14

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-124			11/9/16 11:57
3	Spec-Service & Location	Middle Bay (D/E) Garage Roof			11/9/16 11:57
4	Spec-Air Flow	3445 l/s			11/9/16 11:57
5	Spec-S.P.	83 Pa			11/9/16 11:57
6	Spec-Motor (Hp)	1 1/2			11/9/16 11:57
7	Spec-RPM	864			11/9/16 11:57
8	Spec-Sones	69 dBA			11/9/16 11:57
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:57

General - EF-14

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-14

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-14

Pre-Functional Checks - EF-14

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-15

Design - EF-15

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-110			11/9/16 11:59
3	Spec-Service & Location	East Bay (M) Garage Roof			11/9/16 11:59
4	Spec-Air Flow	1140 l/s			11/9/16 11:59
5	Spec-S.P.	250 Pa			11/9/16 11:59
6	Spec-Motor (Hp)	3			11/9/16 11:59
7	Spec-RPM	1508			11/9/16 11:59
8	Spec-Sones	72 dBA			11/9/16 11:59
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:59

General - EF-15

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-15

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-15

Pre-Functional Checks - EF-15

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-16

Design - EF-16

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-113			11/9/16 12:01
3	Spec-Service & Location	East Bay (P) Garage Roof			11/9/16 12:01
4	Spec-Air Flow	1980 l/s			11/9/16 12:01
5	Spec-S.P.	250 Pa			11/9/16 12:01
6	Spec-Motor (Hp)	3			11/9/16 12:01
7	Spec-RPM	1953			11/9/16 12:01
8	Spec-Sones	72 dBA			11/9/16 12:01
9	Spec-Electrical	208v/3ph/60hz			11/9/16 12:01

General - EF-16

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-16

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-16

Pre-Functional Checks - EF-16

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-17

Design - EF-17

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-110			11/9/16 11:59
3	Spec-Service & Location	Hose Reel, Centre (E) Garage Roof			11/9/16 12:04
4	Spec-Air Flow	650 l/s			11/9/16 12:04
5	Spec-S.P.	250 Pa			11/9/16 11:59
6	Spec-Motor (Hp)	3			11/9/16 11:59
7	Spec-RPM	1508			11/9/16 11:59
8	Spec-Sones	72 dBA			11/9/16 11:59
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:59

General - EF-17

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-17

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-17

Pre-Functional Checks - EF-17

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-18

Design - EF-18

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-110			11/9/16 11:59
3	Spec-Service & Location	Hose Reel, North (E/G) Garage Roof			11/9/16 12:49
4	Spec-Air Flow	650 l/s			11/9/16 12:04
5	Spec-S.P.	250 Pa			11/9/16 11:59
6	Spec-Motor (Hp)	3			11/9/16 11:59
7	Spec-RPM	1508			11/9/16 11:59
8	Spec-Sones	72 dBA			11/9/16 11:59
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:59

General - EF-18

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-18

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-18

Pre-Functional Checks - EF-18

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-19

Design - EF-19

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-110			11/9/16 11:59
3	Spec-Service & Location	Hose Reel, NorthEast (J/O) Garage Roof			11/9/16 12:51
4	Spec-Air Flow	975 l/s			11/9/16 12:52
5	Spec-S.P.	250 Pa			11/9/16 11:59
6	Spec-Motor (Hp)	3			11/9/16 11:59
7	Spec-RPM	1508			11/9/16 11:59
8	Spec-Sones	72 dBA			11/9/16 11:59
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:59

General - EF-19

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-19

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-19

Pre-Functional Checks - EF-19

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-2

Design - EF-2

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	GB-220-10			6/3/16 8:10
3	Spec-Service & Location	Level1 Warehouse/Warden Roof			6/3/16 8:10
4	Spec-Air Flow	2360 l/s			6/2/16 16:59
5	Spec-S.P.	124 Pa			6/3/16 8:10
6	Spec-Motor (Hp)	1			6/3/16 8:10
7	Spec-RPM	786			6/3/16 8:10
8	Spec-Sones	66 dBA			6/3/16 8:51
9	Spec-Electrical	208/3ph/60hz			6/2/16 16:59

General - EF-2

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-2

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-2

Pre-Functional Checks - EF-2

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-20

Design - EF-20

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	SWB-110			11/9/16 11:59
3	Spec-Service & Location	Hose Reel, SouthEast (N/O) Garage Roof			11/9/16 12:54
4	Spec-Air Flow	650 l/s			11/9/16 12:04
5	Spec-S.P.	250 Pa			11/9/16 11:59
6	Spec-Motor (Hp)	3			11/9/16 11:59
7	Spec-RPM	1508			11/9/16 11:59
8	Spec-Sones	72 dBA			11/9/16 11:59
9	Spec-Electrical	208v/3ph/60hz			11/9/16 11:59

General - EF-20

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-20

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-20

Pre-Functional Checks - EF-20

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-21

Design - EF-21

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-065-VG			6/3/16 8:47
3	Spec-Service & Location	WC Exhaust/Garage Roof			11/9/16 13:03
4	Spec-Air Flow	177 l/s			11/9/16 13:03
5	Spec-S.P.	62 Pa			6/3/16 8:24
6	Spec-Motor (Hp)	frac			11/9/16 13:03
7	Spec-RPM	1411			6/3/16 8:47
8	Spec-Sones	42 dBA			6/3/16 8:47
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-21

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-21

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-21

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-21

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-22

Design - EF-22

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-065-VG			6/3/16 8:47
3	Spec-Service & Location	WC Exhaust/Garage Roof			11/9/16 13:03
4	Spec-Air Flow	177 l/s			11/9/16 13:03
5	Spec-S.P.	62 Pa			6/3/16 8:24
6	Spec-Motor (Hp)	frac			11/9/16 13:03
7	Spec-RPM	1411			6/3/16 8:47
8	Spec-Sones	42 dBA			6/3/16 8:47
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-22

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-22

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-22

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-22

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-23

Design - EF-23

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	GB-161-4			11/9/16 13:13
3	Spec-Service & Location	Welding General Exhaust/Garage Roof			11/9/16 13:13
4	Spec-Air Flow	755 l/s			11/9/16 13:13
5	Spec-S.P.	62 Pa			11/9/16 13:13
6	Spec-Motor (Hp)	1/4			11/9/16 13:13
7	Spec-RPM	1725 rpm			11/9/16 13:13
8	Spec-Electrical	115v/1ph/60hz			6/3/16 8:19

General - EF-23

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-23

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-23

Pre-Functional Checks - EF-23

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-24

Design - EF-24

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-060-D			6/3/16 8:19
3	Spec-Service & Location	Shower Rm/Trades Ceiling Plenum			11/9/16 13:15
4	Spec-Air Flow	35 l/s			6/3/16 8:19
5	Spec-S.P.	62 Pa			11/9/16 13:15
6	Spec-Motor (Hp)	1/60			6/3/16 8:19
7	Spec-RPM	1550			6/3/16 8:19
8	Spec-Sones	44 dBA			6/3/16 8:19
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:19

General - EF-24

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-24

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-24

Pre-Functional Checks - EF-24

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-25

Design - EF-25

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	FJC-315-10-BI-7			11/9/16 13:20
3	Spec-Service & Location	Paint rm general exhaust/Paint rm roof			11/9/16 13:20
4	Spec-Air Flow	718 l/s			11/9/16 13:20
5	Spec-S.P.	249 Pa			11/9/16 13:20
6	Spec-Motor (Hp)	3/4			11/9/16 13:20
7	Spec-RPM	1317			11/9/16 13:20
8	Spec-Electrical	208v/3ph/60hz			11/9/16 13:20

General - EF-25

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-25

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-25

Pre-Functional Checks - EF-25

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-26

Design - EF-26

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	FJC-315-10-BI-7			11/9/16 13:20
3	Spec-Service & Location	Paint rm Hood exhaust/Paint rm roof			11/9/16 13:22
4	Spec-Air Flow	1061 l/s			11/9/16 13:22
5	Spec-S.P.	125 Pa			11/9/16 13:22
6	Spec-Motor (Hp)	3/4			11/9/16 13:20
7	Spec-RPM	1381			11/9/16 13:22
8	Spec-Electrical	208v/3ph/60hz			11/9/16 13:20

General - EF-26

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-26

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-26

Pre-Functional Checks - EF-26

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-3

Design - EF-3

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-095-VG			6/3/16 8:44
3	Spec-Service & Location	Washroom (133/134)/Warden Roof			6/3/16 8:14
4	Spec-Air Flow	400 l/s			6/3/16 8:14
5	Spec-S.P.	93 Pa			6/3/16 8:14
6	Spec-Motor (Hp)	1/6			6/3/16 8:14
7	Spec-RPM	1725			6/3/16 8:14
8	Spec-Sones	60 dBA			6/3/16 8:51
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-3

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-3

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-3

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-3

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-4

Design - EF-4

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-060-D			6/3/16 8:19
3	Spec-Service & Location	Janitor (138)/Warden Roof			6/3/16 8:19
4	Spec-Air Flow	35 l/s			6/3/16 8:19
5	Spec-S.P.	44 Pa			6/3/16 8:19
6	Spec-Motor (Hp)	1/60			6/3/16 8:19
7	Spec-RPM	1550			6/3/16 8:19
8	Spec-Sones	44 dBA			6/3/16 8:19
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:19

General - EF-4

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-4

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-4

Pre-Functional Checks - EF-4

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-5

Design - EF-5

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-060-D			6/3/16 8:19
3	Spec-Service & Location	Washroom (Dispatch) Warden Roof			6/3/16 8:21
4	Spec-Air Flow	35 l/s			6/3/16 8:19
5	Spec-S.P.	44 Pa			6/3/16 8:19
6	Spec-Motor (Hp)	1/60			6/3/16 8:19
7	Spec-RPM	1550			6/3/16 8:19
8	Spec-Sones	44 dBA			6/3/16 8:19
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:19

General - EF-5

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-5

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-5

Pre-Functional Checks - EF-5

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Ducting Properly Sealed & Acoustic Lining Intact				
3	Duct is Externally Insulated 3m from Roof Opening				
4	Flexible Connectors Correct				
5	Plenums Clear of Debris				
6	Controls/Interlocks Complete				
7	Vibration Isolation Installed				
8	Service Space is adequate				
9	Unit is Clean				
10	Disconnect Installed & Correct Location				
11	Permanent Labels. Equip Tag Affixed				
12	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
13	Fan Bearings Lubricated				
14	Impeller Rotates Freely				
15	Belts Adjusted and Aligned & Belt Guards Installed				
16	Installation and Mounting is Secure				
17	Shipping Blocks Removed				
18	According to Shop Drawings				

	Verification	Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				
6	PRE INTERM- All Bearings Re-Lubricated				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-6

Design - EF-6

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-070-VG			6/3/16 8:24
3	Spec-Service & Location	Lunchroom (145)/Warden Roof			6/3/16 8:24
4	Spec-Air Flow	80 l/s			6/3/16 8:24
5	Spec-S.P.	62 Pa			6/3/16 8:24
6	Spec-Motor (Hp)	1/10			6/3/16 8:24
7	Spec-RPM	1376			6/3/16 8:24
8	Spec-Sones	43 dBA			6/3/16 8:24
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-6

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-6

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-6

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-6

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-7

Design - EF-7

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-065-VG			6/3/16 8:47
3	Spec-Service & Location	Washroom (143/144)/Warden Roof			6/3/16 8:47
4	Spec-Air Flow	47 l/s			6/3/16 8:47
5	Spec-S.P.	62 Pa			6/3/16 8:24
6	Spec-Motor (Hp)	1/10			6/3/16 8:24
7	Spec-RPM	1411			6/3/16 8:47
8	Spec-Sones	42 dBA			6/3/16 8:47
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-7

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-7

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-7

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-7

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-8

Design - EF-8

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-070-VG			6/3/16 8:24
3	Spec-Service & Location	Lunchroom (132)/Warden Roof			6/3/16 8:48
4	Spec-Air Flow	80 l/s			6/3/16 8:24
5	Spec-S.P.	62 Pa			6/3/16 8:24
6	Spec-Motor (Hp)	1/10			6/3/16 8:24
7	Spec-RPM	1376			6/3/16 8:24
8	Spec-Sones	43 dBA			6/3/16 8:24
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-8

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-8

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-8

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-8

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-9

Design - EF-9

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Greenheck			6/2/16 16:59
2	Spec-Model	G-070-VG			6/3/16 8:24
3	Spec-Service & Location	Electrical Rm/Tech Service Roof			11/9/16 11:47
4	Spec-Air Flow	80 l/s			6/3/16 8:24
5	Spec-S.P.	62 Pa			6/3/16 8:24
6	Spec-Motor (Hp)	1/10			6/3/16 8:24
7	Spec-RPM	1376			6/3/16 8:24
8	Spec-Sones	43 dBA			6/3/16 8:24
9	Spec-Electrical	115v/1ph/60hz			6/3/16 8:14

General - EF-9

	Verification	Response	Notes	By	Date/Time
1	Location				
2	System				

Installation - EF-9

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model				
3	Serial #				
4	Type/Mark				
5	Air Flow				
6	External Static Pressure				
7	Motor				
8	Motor Power				

Pre-Functional Checks - EF-9

	Verification	Response	Notes	By	Date/Time
1	Ducting Properly Supported				
2	Duct is Externally Insulated 3m from Roof Opening				
3	Flexible Connectors Correct				
4	Plenums Clear of Debris				
5	Controls/Interlocks Complete				
6	Vibration Isolation Installed				
7	Service Space is adequate				
8	Unit is Clean				
9	Disconnect Installed & Correct Location				
10	Permanent Labels. Equip Tag Affixed				
11	Casing Condition Good: no dents, leaks, door/cover gaskets installed				
12	Impeller Rotates Freely				
13	Installation and Mounting is Secure				
14	Shipping Blocks Removed				
15	According to Shop Drawings				

Fan

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: EF-9

Verification		Response	Notes	By	Date/Time
1	START UP- Started as per Mftrs Requirements				
2	START UP- Fan Rotation is Correct				
3	START UP- No Noise & Vibration				
4	START UP- Controls Operational				
5	POST START- TAB Complete				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-1

Design - MUA-1

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	HE-70			11/9/16 10:52
3	Spec-Type	Indirect Fired			6/2/16 15:00
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	175.7/140.6			11/9/16 10:52
6	Spec Location	Warden Roof for Basement Locker Rm			11/9/16 10:59
7	Spec-Air Volume/RPM	2360l/s - 1329 rpm			11/9/16 10:52
8	Spec-Static Pressure	560 Pa			11/9/16 10:52
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-1

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-1

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-1

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-1

Pre-Functional Checks - MUA-1

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-2

Design - MUA-2

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	HE-70			11/9/16 10:58
3	Spec-Type	Indirect Fired			11/9/16 10:58
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	175.7/140.6 KW			11/9/16 10:58
6	Spec Location	Warden Roof for Level 1 Warehouse			11/9/16 10:58
7	Spec-Air Volume/RPM	2515l/s- 1156rpm			11/9/16 10:58
8	Spec-Static Pressure	350 Pa			11/9/16 10:58
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-2

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-2

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-2

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-2

Pre-Functional Checks - MUA-2

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-3

Design - MUA-3

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	RT-160			11/9/16 11:01
3	Spec-Type	Indirect Fired			6/2/16 15:00
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	42.2/33.8 kW			11/9/16 11:01
6	Spec Location	Warden Roof for Tech Service Wing			11/9/16 11:01
7	Spec-Air Volume/RPM	767l/s- 1270 rpm			11/9/16 11:01
8	Spec-Static Pressure	250 Pa			11/9/16 11:01
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-3

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-3

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-3

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-3

Pre-Functional Checks - MUA-3

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-4

Design - MUA-4

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	DJX-40 18/18			11/9/16 11:03
3	Spec-Type	Indirect Fired			6/2/16 15:00
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	117.2/105.5 kW			11/9/16 11:03
6	Spec Location	Trades Boiler rm for Trades Wing			11/9/16 11:03
7	Spec-Air Volume/RPM	2656l/s- 1200rpm			11/9/16 11:03
8	Spec-Static Pressure	137 Pa			11/9/16 11:03
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-4

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-4

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-4

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-4

Pre-Functional Checks - MUA-4

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-5

Design - MUA-5

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	HE-171 22/22			11/9/16 11:06
3	Spec-Type	Direct Fired			6/2/16 15:59
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	433kW			11/9/16 11:05
6	Spec Location	Garage Roof for North Bays			11/9/16 11:05
7	Spec-Air Volume/RPM	6338l/s- 639 rpm			11/9/16 11:05
8	Spec-Static Pressure	100 Pa			11/9/16 11:05
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-5

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-5

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-5

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-5

Pre-Functional Checks - MUA-5

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-6

Design - MUA-6

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	HE171 22/22			11/9/16 11:08
3	Spec-Type	Direct Fired			6/2/16 15:59
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	433 kW			11/9/16 11:07
6	Spec Location	Garage Roof for NorthEast Bays			11/9/16 11:07
7	Spec-Air Volume/RPM	6338l/s - 639 rpm			11/9/16 11:07
8	Spec-Static Pressure	100 Pa			11/9/16 11:07
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-6

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-6

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-6

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-6

Pre-Functional Checks - MUA-6

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-7

Design - MUA-7

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Engineered Air			6/2/16 15:00
2	Spec-Model #	HE-131 20/18			11/9/16 11:10
3	Spec-Type	Direct Fired			6/2/16 15:59
4	Spec Fuel	Natural Gas			6/2/16 15:00
5	Spec Heating Input/Output	324.4 kW			11/9/16 11:10
6	Spec Location	Garage Roof for Machine Shop			11/9/16 11:10
7	Spec-Air Volume/RPM	4748l/s - 748 rpm			11/9/16 11:10
8	Spec-Static Pressure	150 Pa			11/9/16 11:10
9	Spec-Motor (V/PH./RPM)	208v/3ph/60hz			6/2/16 15:00

Operational Performance Test - MUA-7

	Verification	Response	Notes	By	Date/Time
1	Outdoor Dampers Functional				
2	Interlocks Confirmed and Working				
3	Alarms/Indicators Functional				
4	Fan Rotation Correct				
5	Gas Train Operation Confirmed				
6	Flame Control Device Working				
7	Temperature Control Operational				

General - MUA-7

	Verification	Response	Notes	By	Date/Time
1	Location				
2	Service				
3	System				
4	BMS Mneumonic				

Installation - MUA-7

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Model #				
3	Type				
4	Temperature Rise				
5	Air Volume/RPM				
6	Static Pressure				
7	Motor (V./PH./RPM)				
8	Serial No.				
9	Heat Input				
10	Heat Output				
11	Filter Size				

Make Up Air Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: MUA-7

Pre-Functional Checks - MUA-7

	Verification	Response	Notes	By	Date/Time
1	Filters Installed Functional				
2	Access Doors				
3	Cabinet Conditioning clean				
4	Duct Connections Aligned				
5	Insulation Condition good				
6	Cabinet Insulation in place				
7	Fan Housing				
8	Bearing Type				
9	Alignment				
10	Local Disconnect Installed				
11	Mag. Starter Operational				
12	Overload Protection in Place				
13	Thrust Absorbers Functional				
14	Belt Size/No.				
15	Vibration Isolation Functional				
16	Flex Connections Operational				
17	Fire Dampers Functional				
18	Access is reasonable				
19	Belt Tension Checked				

	Verification	Response	Notes	By	Date/Time
1	High altitude rated				
2	No signs of poor combustion				
3	All Bearings re-lubricated				
4	Fan rotation correct				
5	Started as per Manufacturers requirements				
6	Filters Merv 8				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-1

Design - P-1

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Armstrong			6/3/16 9:37
2	Spec-Model/Series #	4380 DE 0206-001.5			11/9/16 13:49
3	Spec-Location	Trades Boiler Room			11/9/16 13:49
4	Spec-Service	Boiler Pump			6/3/16 9:37
5	Spec-Media	Water			6/3/16 9:37
6	Spec-Flow	8.1 l/s			11/9/16 13:49
7	Spec-Head	51.0 kPa			11/9/16 13:49
8	Spec-Motor	1.5 hp			6/3/16 9:37
9	Spec-RPM	1750			6/3/16 9:37
10	Spec-Electrical (V/Ph/Hz)	208v/3ph/60hz			6/3/16 9:37
11	Spec-Type/Mark	Inline			6/3/16 9:37

General - P-1

	Verification	Response	Notes	By	Date/Time
1	BMS Tag/Mnemonic				
2	Location				
3	Description				
4	Duty				

Installation - P-1

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Service				
3	Model #				
4	Serial #				
5	Type/Mark				
6	Media				
7	Fluid Flow				
8	Head Pressure	kPa			
9	Motor				
10	MOTOR (V/PH./RPM)				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-1

Pre-Functional Checks - P-1

	Verification	Response	Notes	By	Date/Time
1	Installed according to Drawings				
2	Installation and mounting is secure				
3	Pump is Level				
4	Vibration Isolation Installed				
5	Motor and Pump Aligned				
6	Straight length on Suction side as recommended				
7	Service space is adequate				
8	Pressure gauges installed				
9	Valves and strainers installed				
10	Check valve location and direction of fluid flow is correct				
11	Controls/Interlocks Complete				
12	Unit is clean				
13	Power disconnect installed				
14	Permanent Labels and equipment tags installed				
15	Name plate is visible				
16	Pipes Properly labelled				
17	Pipes properly insulated				
18	Piping System properly flushed				
19	Valves properly tagged				

	Verification	Response	Notes	By	Date/Time
1	Started as per Manufacturers Requirements				
2	Pump Rotation Correct				
3	Strainers Cleaned				
4	Air Flow for Motor Cooling OK				
5	Pump functional in AUTO mode				
6	Pump functional in HAND mode				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-2

Design - P-2

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Armstrong			6/3/16 9:37
2	Spec-Model/Series #	4380 DE 0206-001.5			11/9/16 13:49
3	Spec-Location	Trades Boiler Room			11/9/16 13:49
4	Spec-Service	Boiler Pump			6/3/16 9:37
5	Spec-Media	Water			6/3/16 9:37
6	Spec-Flow	8.1 l/s			11/9/16 13:49
7	Spec-Head	51.0 kPa			11/9/16 13:49
8	Spec-Motor	1.5 hp			6/3/16 9:37
9	Spec-RPM	1750			6/3/16 9:37
10	Spec-Electrical (V/Ph/Hz)	208v/3ph/60hz			6/3/16 9:37
11	Spec-Type/Mark	Inline			6/3/16 9:37

General - P-2

	Verification	Response	Notes	By	Date/Time
1	BMS Tag/Mnemonic				
2	Location				
3	Description				
4	Duty				

Installation - P-2

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Service				
3	Model #				
4	Serial #				
5	Type/Mark				
6	Media				
7	Fluid Flow				
8	Head Pressure	kPa			
9	Motor				
10	MOTOR (V/PH./RPM)				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-2

Pre-Functional Checks - P-2

	Verification	Response	Notes	By	Date/Time
1	Installed according to Drawings				
2	Installation and mounting is secure				
3	Pump is Level				
4	Vibration Isolation Installed				
5	Motor and Pump Aligned				
6	Straight length on Suction side as recommended				
7	Service space is adequate				
8	Pressure gauges installed				
9	Valves and strainers installed				
10	Check valve location and direction of fluid flow is correct				
11	Controls/Interlocks Complete				
12	Unit is clean				
13	Power disconnect installed				
14	Permanent Labels and equipment tags installed				
15	Name plate is visible				
16	Pipes Properly labelled				
17	Pipes properly insulated				
18	Piping System properly flushed				
19	Valves properly tagged				

	Verification	Response	Notes	By	Date/Time
1	Started as per Manufacturers Requirements				
2	Pump Rotation Correct				
3	Strainers Cleaned				
4	Air Flow for Motor Cooling OK				
5	Pump functional in AUTO mode				
6	Pump functional in HAND mode				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-3

Design - P-3

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Armstrong			6/3/16 9:37
2	Spec-Model/Series #	4380 1506-003.0			11/9/16 13:54
3	Spec-Location	Trades Boiler Room			11/9/16 13:52
4	Spec-Service	HW Circulator, Warden			11/9/16 13:52
5	Spec-Media	Water			6/3/16 9:37
6	Spec-Flow	4.16 l/s			11/9/16 13:52
7	Spec-Head	114.2 Pa			11/9/16 13:52
8	Spec-Motor	3			11/9/16 13:52
9	Spec-RPM	1750			6/3/16 9:37
10	Spec-Electrical (V/Ph/Hz)	208v/3ph/60hz			6/3/16 9:37
11	Spec-Type/Mark	Inline			6/3/16 9:37

General - P-3

	Verification	Response	Notes	By	Date/Time
1	BMS Tag/Mnemonic				
2	Location				
3	Description				
4	Duty				

Installation - P-3

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Service				
3	Model #				
4	Serial #				
5	Type/Mark				
6	Media				
7	Fluid Flow				
8	Head Pressure	kPa			
9	Motor				
10	MOTOR (V/PH./RPM)				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-3

Pre-Functional Checks - P-3

	Verification	Response	Notes	By	Date/Time
1	Installed according to Drawings				
2	Installation and mounting is secure				
3	Pump is Level				
4	Vibration Isolation Installed				
5	Motor and Pump Aligned				
6	Straight length on Suction side as recommended				
7	Service space is adequate				
8	Pressure gauges installed				
9	Valves and strainers installed				
10	Check valve location and direction of fluid flow is correct				
11	Controls/Interlocks Complete				
12	Unit is clean				
13	Power disconnect installed				
14	Permanent Labels and equipment tags installed				
15	Name plate is visible				
16	Pipes Properly labelled				
17	Pipes properly insulated				
18	Piping System properly flushed				
19	Valves properly tagged				

	Verification	Response	Notes	By	Date/Time
1	Started as per Manufacturers Requirements				
2	Pump Rotation Correct				
3	Strainers Cleaned				
4	Air Flow for Motor Cooling OK				
5	Pump functional in AUTO mode				
6	Pump functional in HAND mode				
7	VFD start up completed				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-4

Design - P-4

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Armstrong			6/3/16 9:37
2	Spec-Model/Series #	4380 1506-003.0			11/9/16 13:53
3	Spec-Location	Trades Boiler Room			11/9/16 13:52
4	Spec-Service	HW Circulator, Warden			11/9/16 13:52
5	Spec-Media	Water			6/3/16 9:37
6	Spec-Flow	4.16 l/s			11/9/16 13:52
7	Spec-Head	114.2 Pa			11/9/16 13:52
8	Spec-Motor	3			11/9/16 13:52
9	Spec-RPM	1750			6/3/16 9:37
10	Spec-Electrical (V/Ph/Hz)	208v/3ph/60hz			6/3/16 9:37
11	Spec-Type/Mark	Inline			6/3/16 9:37

General - P-4

	Verification	Response	Notes	By	Date/Time
1	BMS Tag/Mnemonic				
2	Location				
3	Description				
4	Duty				

Installation - P-4

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Service				
3	Model #				
4	Serial #				
5	Type/Mark				
6	Media				
7	Fluid Flow				
8	Head Pressure	kPa			
9	Motor				
10	MOTOR (V/PH./RPM)				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-4

Pre-Functional Checks - P-4

	Verification	Response	Notes	By	Date/Time
1	Installed according to Drawings				
2	Installation and mounting is secure				
3	Pump is Level				
4	Vibration Isolation Installed				
5	Motor and Pump Aligned				
6	Straight length on Suction side as recommended				
7	Service space is adequate				
8	Pressure gauges installed				
9	Valves and strainers installed				
10	Check valve location and direction of fluid flow is correct				
11	Controls/Interlocks Complete				
12	Unit is clean				
13	Power disconnect installed				
14	Permanent Labels and equipment tags installed				
15	Name plate is visible				
16	Pipes Properly labelled				
17	Pipes properly insulated				
18	Piping System properly flushed				
19	Valves properly tagged				

	Verification	Response	Notes	By	Date/Time
1	Started as per Manufacturers Requirements				
2	Pump Rotation Correct				
3	Strainers Cleaned				
4	Air Flow for Motor Cooling OK				
5	Pump functional in AUTO mode				
6	Pump functional in HAND mode				
7	VFD start up completed				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-5

Design - P-5

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Armstrong			6/3/16 9:37
2	Spec-Model/Series #	4380 DE 1506-003.0			11/9/16 13:57
3	Spec-Location	Trades Boiler Room			6/3/16 9:47
4	Spec-Service	HW Circulator, Trades			11/9/16 13:57
5	Spec-Media	Water			6/3/16 9:37
6	Spec-Flow	5.05 l/s			11/9/16 13:57
7	Spec-Head	103.8 Pa			11/9/16 13:57
8	Spec-Motor	2 hp			6/3/16 9:47
9	Spec-RPM	1750			6/3/16 9:37
10	Spec-Electrical (V/Ph/Hz)	208v/3ph/60hz			6/3/16 9:37
11	Spec-Type/Mark	Inline			6/3/16 9:37

General - P-5

	Verification	Response	Notes	By	Date/Time
1	BMS Tag/Mnemonic				
2	Location				
3	Description				
4	Duty				

Installation - P-5

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Service				
3	Model #				
4	Serial #				
5	Type/Mark				
6	Media				
7	Fluid Flow				
8	Head Pressure	kPa			
9	Motor				
10	MOTOR (V/PH./RPM)				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-5

Pre-Functional Checks - P-5

	Verification	Response	Notes	By	Date/Time
1	Installed according to Drawings				
2	Installation and mounting is secure				
3	Pump is Level				
4	Vibration Isolation Installed				
5	Motor and Pump Aligned				
6	Straight length on Suction side as recommended				
7	Service space is adequate				
8	Pressure gauges installed				
9	Valves and strainers installed				
10	Check valve location and direction of fluid flow is correct				
11	Controls/Interlocks Complete				
12	Unit is clean				
13	Power disconnect installed				
14	Permanent Labels and equipment tags installed				
15	Name plate is visible				
16	Pipes Properly labelled				
17	Pipes properly insulated				
18	Piping System properly flushed				
19	Valves properly tagged				

	Verification	Response	Notes	By	Date/Time
1	Started as per Manufacturers Requirements				
2	Pump Rotation Correct				
3	Strainers Cleaned				
4	Air Flow for Motor Cooling OK				
5	Pump functional in AUTO mode				
6	Pump functional in HAND mode				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-6

Design - P-6

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Armstrong			6/3/16 9:37
2	Spec-Model/Series #	4380 DE 1506-003.0			11/9/16 13:57
3	Spec-Location	Trades Boiler Room			6/3/16 9:47
4	Spec-Service	HW Circulator, Trades			11/9/16 13:57
5	Spec-Media	Water			6/3/16 9:37
6	Spec-Flow	5.05 l/s			11/9/16 13:57
7	Spec-Head	103.8 Pa			11/9/16 13:57
8	Spec-Motor	2 hp			6/3/16 9:47
9	Spec-RPM	1750			6/3/16 9:37
10	Spec-Electrical (V/Ph/Hz)	208v/3ph/60hz			6/3/16 9:37
11	Spec-Type/Mark	Inline			6/3/16 9:37

General - P-6

	Verification	Response	Notes	By	Date/Time
1	BMS Tag/Mnemonic				
2	Location				
3	Description				
4	Duty				

Installation - P-6

	Verification	Response	Notes	By	Date/Time
1	Manufacturer				
2	Service				
3	Model #				
4	Serial #				
5	Type/Mark				
6	Media				
7	Fluid Flow				
8	Head Pressure	kPa			
9	Motor				
10	MOTOR (V/PH./RPM)				

Pump

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: P-6

Pre-Functional Checks - P-6

	Verification	Response	Notes	By	Date/Time
1	Installed according to Drawings				
2	Installation and mounting is secure				
3	Pump is Level				
4	Vibration Isolation Installed				
5	Motor and Pump Aligned				
6	Straight length on Suction side as recommended				
7	Service space is adequate				
8	Pressure gauges installed				
9	Valves and strainers installed				
10	Check valve location and direction of fluid flow is correct				
11	Controls/Interlocks Complete				
12	Unit is clean				
13	Power disconnect installed				
14	Permanent Labels and equipment tags installed				
15	Name plate is visible				
16	Pipes Properly labelled				
17	Pipes properly insulated				
18	Piping System properly flushed				
19	Valves properly tagged				

	Verification	Response	Notes	By	Date/Time
1	Started as per Manufacturers Requirements				
2	Pump Rotation Correct				
3	Strainers Cleaned				
4	Air Flow for Motor Cooling OK				
5	Pump functional in AUTO mode				
6	Pump functional in HAND mode				

Rooftop Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RTU-1

Design - RTU-1

	Verification	Response	Notes	By	Date/Time
1	Spec-Manufacturer	Carrier			6/2/16 16:04
2	Spec-Model #	48VLB240603			6/2/16 16:04
3	Spec Input/Output	14.6/12.1 kW			6/2/16 16:04
4	Spec-Air Volume	404 L/sec cfm			6/2/16 16:04
5	Spec-E.S.P.	87 Pa " W.C.			6/2/16 16:04
6	Spec Supply Fan Motor	0.37 kW			6/2/16 16:04
7	Spec - Cooling Capacity Total	6.8 kW			6/2/16 16:19
8	Spec - Cooling Capacity Sensible	4.9 kW			6/2/16 16:19
9	Spec - Filter Eff	Merv 8			6/2/16 16:19
10	Specified c/w Economizer	Yes			6/2/16 16:19
11	Spec c/w GFCI receptacle	Yes			6/2/16 16:19

General - RTU-1

	Verification	Response	Notes	By	Date/Time
1	Service				
2	Air Handing System				
3	Location				
4	BMS Tag#/Mnemonic				

Installation - RTU-1

	Verification	Response	Notes	By	Date/Time
1	Serial #				
2	Manufacturer				
3	Model				
4	Type				
5	Heating Capacity Input/Output	kW BTUH			
6	Cooling Capacity Total	kW Tons			
7	Air Volume				
8	E.S.P.	Pa " W.C.			
9	Electrical				
10	Refrigerant				
11	Filter Eff				
12	Cooling Capacity Sensible				
13	c/w Economizer				
14	c/w GFCI receptacle				

Rooftop Unit

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: RTU-1

Pre-Functional Checks - RTU-1

Verification		Response	Notes	By	Date/Time
1	Thermostat is wired to unit and functional				
2	Unit is tagged and identified				
3	All doors and access secured and in place				
4	Economizer is installed and operational				
5	Power Exhaust fan is installed and operational				
6	Condensate trap is installed correctly				
7	Filters installed and clean				
8	Supply Fan Motor				

Panel Boards

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: Panel GP

General - Panel GP

	Verification	Response	Notes	By	Date/Time
1	Panel Location				

Installation - Panel GP

	Verification	Response	Notes	By	Date/Time
1	Volt/Phase/Wire				
2	Isolated Ground				
3	Main Breaker Size				
4	Feeder Size				
5	Control Contactor Size				
6	No. of Circuits				
7	Bus Bracing kA				
8	Mounting (F/S)				
9	Surge Suppression				
10	Manufacturer				
11	Load Served				
12	Model No.				
13	Bus Amp Rating				
14	Circuit Breaker Int. Rating				
15	Fed From				
16	Feeder Main Brk./Fuse Size				
17	Specified Circuits				
18	Bonding Conductor Size				
19	Bus (Al or Cu)				
20	No. of Breakers				
21	Breakers Size/Type				
22	Breaker Int. Rating				

Pre-Functional Checks - Panel GP

	Verification	Response	Notes	By	Date/Time
1	Nameplate Complete				
2	Identification Lamacoid				
3	Cable and Wiring Identifications				
4	Spare Conduit Stub-ups				
5	Breaker Lock-On Device*				
6	Filler Pieces in Place				
7	Door and Key Lock				
8	Grounding of Equipment				
9	Typewritten Panel Directory Confirmed				
10	Condition of Assembly & Paint Finish				
11	Equipment Cleanliness (Interior free of dust)				
12	Clearance around Equipment				

Panel Boards

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: Panel GP

Verification		Response	Notes	By	Date/Time
1	Cable and Wiring Identifications				
2	Door and Key Lock				
3	Identifcation Lamacoid				
4	Spare Conduit Stub-ups				
5	Typewritten Panel Directory Confirmed				
6	Grounding of Equipment				

Panel Boards

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: Panel TY

General - Panel TY

	Verification	Response	Notes	By	Date/Time
1	Panel Location				

Installation - Panel TY

	Verification	Response	Notes	By	Date/Time
1	Volt/Phase/Wire				
2	Isolated Ground				
3	Main Breaker Size				
4	Feeder Size				
5	Control Contactor Size				
6	No. of Circuits				
7	Bus Bracing kA				
8	Mounting (F/S)				
9	Surge Suppression				
10	Manufacturer				
11	Load Served				
12	Model No.				
13	Bus Amp Rating				
14	Circuit Breaker Int. Rating				
15	Fed From				
16	Feeder Main Brk./Fuse Size				
17	Specified Circuits				
18	Bonding Conductor Size				
19	Bus (Al or Cu)				
20	No. of Breakers				
21	Breakers Size/Type				
22	Breaker Int. Rating				

Pre-Functional Checks - Panel TY

	Verification	Response	Notes	By	Date/Time
1	Nameplate Complete				
2	Identification Lamacoid				
3	Cable and Wiring Identifications				
4	Spare Conduit Stub-ups				
5	Breaker Lock-On Device*				
6	Filler Pieces in Place				
7	Door and Key Lock				
8	Grounding of Equipment				
9	Typewritten Panel Directory Confirmed				
10	Condition of Assembly & Paint Finish				
11	Equipment Cleanliness (Interior free of dust)				
12	Clearance around Equipment				

Panel Boards

PROJECT: Banff Maintenance Compound Rehabilitation
LOCATION: Banff, AB
PROJECT #: 0187-15

DATE: 11/9/2016
CONTACT: Phil Larkin
AUTHOR:

SYSTEM/UNIT: Panel TY

Verification		Response	Notes	By	Date/Time
1	Cable and Wiring Identifications				
2	Door and Key Lock				
3	Identifcation Lamacoid				
4	Spare Conduit Stub-ups				
5	Typewritten Panel Directory Confirmed				
6	Grounding of Equipment				

Approved: 2006-03-31

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

1.2 REFERENCES

.1 American Water Works Association (AWWA)

.2 Public Works and Government Services Canada (PWGSC)

.1 PWGSC - Commissioning Guidelines -4th edition-.

.3 Underwriters' Laboratories of Canada (ULC)

.4 CSA-Z320-11 Building Commissioning Standard

.5 ASHRAE 202-2013 – Commissioning Process for Building and System.

1.3 GENERAL

.1 Provide a fully functional facility:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and under normal loads.

.2 Facility user 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 meet Owner’s design requirements.

.5 Produces a complete functional system prior to substantial completion.

.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 BMM - Building Management Manual.

.3 EMCS - Energy Monitoring and Control Systems.

.4 MSDS - Material Safety Data Sheets.

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting and Balancing.

.8 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 95% completed by the Department Representative and transmit to the Contractor.

.2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:

.1 Approved shop drawings and product data.

.2 Approved changes to contract.

.3 Contractor's project schedule.

.4 Cx schedule.

.5 Contractor's, sub-contractor's, suppliers' requirements.

.6 Project construction team's and Cx team's requirements.

.3 Submit completed Cx Plan to Departmental Representative and obtain written approval.

1.5 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:

.1 Changes resulting from Client program modifications.

.2 Approved design and construction changes.

.2 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to Departmental Representative 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 project and is sole point of contact between members of commissioning team.

.2 Project Manager will select Cx Team consisting of following members:

- .1 Departmental Representative Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
- .2 Departmental Representative Quality Assurance Commissioning Advisor: confirm Cx processes, forms and procedures are developed in the Cx Plan by Departmental Representative to deliver a fully operating project.
- .3 Departmental Representative is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing, certifying accuracy of reported results.
  - .4 Witnessing and certifying TAB and other tests.
  - .5 Developing BMM.
  - .6 Ensuring implementation of final Cx Plan.
  - .7 Performing verification of performance of installed systems and equipment.
  - .8 Implementation of Training Plan. Review of Cx documentation from operational perspective.
  - .9 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
  - .10 Protection of health, safety and comfort of occupants and O&M personnel.
  - .11 Monitoring of Cx activities, training, and development of Cx documentation.
  - .12 Work closely with members of Cx Team
- .4 Construction Team: 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 one person as point of contact with Departmental Representative and Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test reports.

.6 Property 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 Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

1.8 RISK ASSESSMENT

.1 This facility will be occupied at all times. Before taking any system offline ensure staff have either been relocated or steps have been taken to provide temporary services.

.2 Coordinate all activities with Department representative.

.3 Ensure equipment/facility is protected from weather at all times.

1.9 EXTENT OF CX

.1 Commission mechanical systems and associated equipment:

.1 Plumbing systems:

.1 Domestic CWS and HWS.

.2 Storm water drains.

.2 HVAC and exhaust systems:

.1 HVAC systems including MAU, boilers, dampers and pumps.

.2 General exhaust systems.

.3 Exhaust systems and related systems.

.4 Heat recovery systems.

.3 Noise and vibration control systems for mechanical systems.

.4 EMCS:

.2 Commission electrical systems and equipment:

.1 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

1.10 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation.

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties.

.2 Project record documentation.

.3 Inventory of spare parts, special tools and maintenance materials.

.4 Maintenance Management System (MMS) identification system used.

.5 WHMIS information.

.6 MSDS data sheets.

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

.8 Preventive maintenance program.

.9 Contractor’s and sub-contractors’ as built drawings.

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 Cx Specifications.

.2 Startup, pre-Cx activities and documentation for systems, and equipment.

.3 Completed installation checklists (ICL).

.4 Completed product information (PI) report forms.

.5 Completed performance verification (PV) report forms.

.6 Results of Performance Verification Tests and Inspections.

.7 Description of Cx activities and documentation.

.8 Description of Cx of integrated systems and documentation.

.9 Training Plans.

.10 Cx Reports.

.11 Prescribed activities during warranty period.

.4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.

.5 Departmental Representative to participate.

1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:

.1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.

.2 Departmental Representative to use approved check lists.

.3 Departmental Representative will monitor some 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 and certified by Departmental Representative 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 - MECHANICAL:

.1 Plumbing systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 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.

.2 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 approved by Departmental Representative.

.3 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 Departmental Representative 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".

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 including Make up air and Roof top units.

.2 Exhaust fans.

.3 Pumps.

.4 Boilers.

.3 Departmental Representative to monitor some of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of Departmental Representative.

.4 Performance Verification (PV):

.1 Approved Cx Agent to perform.

.1 Repeat when necessary until results are acceptable to Departmental Representative.

.2 Use procedures modified generic procedures to suit project requirements.

.3 Departmental Representative to witness and certify reported results using approved PI and PV forms.

.4 Departmental Representative to approve completed PV reports.

.5 Departmental Representative reserves right to verify up to 30% 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 Departmental Representative.

.2 Departmental Representative to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 Departmental Representative to witness, certify reported results of, Cx activities.

.5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.15 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed by Departmental Representative.

.2 Tests to be witnessed by Departmental Representative and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Departmental Representative.

.4 Departmental Representative reserves right to verify percentage of reported results.

.5 Integrated systems to include:

.1 HVAC and associated systems forming part of integrated HVAC systems.

.2 Environmental space conditions.

.6 Identification:

.1 In later stages of Cx, before hand-over and acceptance Departmental Representative and Cx Manager to co-operate to complete inventory data sheets and provide assistance in full implementation of MMS identification system of components, equipment, sub-systems, 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 and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.20 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Departmental Representative for review and approval 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: 28 days after contract award, and before construction starts.

.3 Cx procedures: 3 months after award of contract.

.4 Cx Report format: 3 months after contract award.

.5 Discussion of heating/cooling loads for Cx: 3 months before start-up.

.6 Notification of intention to start TAB: 21 days before start of TAB.

.7 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.8 Notification of intention to start Cx: 14 days before start of Cx.

.9 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.

.10 Identification of deferred Cx.

.11 Implementation of training plans.

.12 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Facility Manager.

.3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

1.21 CX REPORTS

.1 Submit reports of tests, witnessed and certified by Departmental Representative who will 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 Departmental Representative.

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 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

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 Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Commissioning forms to be completed for equipment, system and integrated system.

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 Departmental Representative 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 Departmental Representative. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) 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 BMM at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's 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 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.

.1 Air Handling Units
.2 Boilers
.3 Reheat Coils
.4 Exhaust Fans
.5 Make-Up Air Units
.6 Pumps
.7 Rooftop Units
.8 Grilles and Dampers
.9 DDC control system
.10 Panel Boards

.2 Revise items on Commissioning forms to suit project requirements.

.3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.

.1 Additional commissioning forms to be in same format as provided by Departmental Representative

1.7 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
.3 Confirm operation as per design criteria and intent.
.4 Identify variances between design and operation and reasons for variances.
.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Verify reported results.

.8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Provide Departmental Representative with originals of completed forms.

.12 Maintain copy on site during start-up, testing and commissioning period.

.13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Commissioning Training.

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility 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 Departmental Representative 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 Maintenance Manual.
.4 Management Manual.
.5 TAB and PV Reports.
.6 System Operation Manual

.3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement training materials:

.1 Transparencies for overhead projectors.
.2 Multimedia presentations.
.3 Manufacturer's training videos.
.4 Equipment models.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,
.2 Coordination among instructors,
.3 Quality of training, training materials,

.2 Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

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.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

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

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Sections 01 33 00 - Submittal Procedures.

.2 Before proceeding with demolition of load bearing walls or of other walls and where required by authority having jurisdiction submit for review by Departmental Representative shoring and underpinning drawings prepared by qualified professional engineer registered or licensed in the Province of Alberta, showing proposed method.

1.3 WASTE MANAGEMENT AND DISPOSAL

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

1.4 SITE CONDITIONS

.1 Should material resembling spray or trowel-applied asbestos, contaminated soil or other designated substance listed as hazardous be encountered that is not identified in DF Technical and Consulting Services Hazardous Material Report, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Do not proceed until written instructions have been received from Departmental Representative.

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

1.5 WASTE MANAGEMENT

.1 Salvage Considerations

.1 There are a variety of materials that will be able to be recycled, confirm requirements with Section 01 74 21.

.2 The removal of all items remaining on site, other than those noted below will be the responsibility of the demolition contractor.

.2 Departmental Representative Retained Products

.1 IT wiring, equipment, and antennae's.

1.6 SALVAGE

.1 The contractor is responsible for the removal of all items associated with the mechanical systems. The contractor will be responsible for maximizing the reuse/recycled content of the equipment and materials that are removed.

.2 The contractor will be responsible for assessing the condition of the equipment and materials. All time and costs associated with the removal, repair, sale, transportation or other associated activities shall be the responsibility of the contractor.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 PREPARATION

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

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

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

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

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

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

3.2 PROTECTION

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

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

.3 Protect building systems, services and equipment.

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

3.3 SITE REMOVALS

.1 Remove items as indicated.

3.4 DISPOSAL

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

END OF SECTION

Part 1 General

1.1 INTENTS

.1 This section specifies general requirements common to all asbestos control work. Read this section in conjunction with related sections that specify requirements for specific procedures and methods for asbestos control.

1.2 RELATED WORK NOT PROVIDED UNDER THIS CONTRACT

.1 Following related work will be performed by Owner's own forces or by user:

.1 Moving of removable furniture and equipment from asbestos control area before work begins.

1.3 RELATED SECTIONS

.1 Section 02 41 99 – Demolition of Minor Works

.2 Appendix - Section 02 82 13 – Asbestos and Lead Paint Abatement

1.4 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-94, Sealer for Application to Asbestos-Fibre Releasing Materials.

.2 CAN/CGSB-43.150-97, Performance Packagings for Transportation of Dangerous Goods.

.2 Guidelines for the Disposal of Asbestos Waste, available from Alberta Environmental Protection.

1.5 DEFINITIONS

.1 Asbestos Control Work: means asbestos containment procedures, removal or encapsulation, and disposal of asbestos or materials containing asbestos, as specified.

.2 Asbestos Control Area: means space in which asbestos control work is being performed and to which general access is prohibited.

.3 Asbestos Waste: means removed contaminant and contaminated materials or products.

.4 Contaminant: means asbestos material.

.5 Contaminated: describes products, by-products, or material containing, or affected by, asbestos or removal thereof.

.6 Full Containment Procedures: means construction of temporary facilities and following of procedures to contain asbestos fibres, as specified in Section 02 82 05.

.7 HEPA Filter: high efficiency particulate air filter, removing not less than 99.97% of particles measuring 0.3 microns and larger, for powered respirators, vacuums, vacuum trucks and negative air units.

.8 P100 Filter: high efficiency, oil proof, particulate air filter, removing not less than 99.97% of particles measuring 0.3 microns and larger, for non powered air purifying respirators.

1.6 WORKER QUALIFICATIONS

.1 Workers used for handling, removal, and packaging for disposal of asbestos waste, shall have completed an asbestos control course acceptable to Alberta Employment, Immigration and Industry, Workplace Health and Safety and be certified to remove asbestos.

.2 At least one employee who will be performing the work shall have completed a first aid course as required by Alberta Occupational Health and Safety Act.

.3 Persons involved in loading, transportation, uploading, and disposal of asbestos waste shall have been trained in accordance with the Dangerous Goods Transportation and Handling Act.

.4 Non-certified workers such as heavy equipment operators may be used for loading and transporting the asbestos containing debris to an approved sanitary landfill site. These workers require dangerous goods training as specified in this section.

1.7 SUBMITTALS

.1 Comply with requirements of this Section and Division 01. Provide submittals prior to start of asbestos control work.

.2 Submit copy of test results documenting Dioctylpthalate (DOP) testing of HEPA filtered vacuums and negative air units.

.3 Submit certification that HEPA filtered vacuums required for this contract meet specified HEPA filter designation for component filter assemblies.

.4 Submit disposal procedure for contaminant and contaminated waste.

.5 Submit a copy of "Manual of Safe Practice" for the work, required by the Occupational Health and Safety Act. Submit proof that Alberta Employment, Immigration and Industry, Workplace Health and Safety has reviewed the manual.

.6 Submit a copy of worker protection information which will be provided to employees.

.7 Submit plan for air monitoring to ensure use of proper respirators within work area.

.8 Submit proof that Alberta Employment, Immigration and Industry, Workplace Health and Safety, has been notified of the asbestos control work to be performed.

.9 Submit proof that all persons involved in the handling, packing, loading, transportation, unloading, and disposal of asbestos waste are trained in accordance with the Dangerous Goods Transportation and Handling Act.

.10 Provide sub-schedule for asbestos control work.

.11 Prior to commencement of work, submit an Asbestos Control Plan. Include the following information:

.1 Locations of:

.1 Asbestos control areas
.2 Change rooms
.3 Isolation/Containment barriers
.4 Decontamination facilities
.5 Negative air units
.6 Exhaust for negative air units

.2 Layout of change rooms.
.3 Sequencing of asbestos related work.

.12 Prior to start of asbestos removal, submit product data for proposed surfactant.

.13 Submit product data for proposed encapsulating sealant.

1.8 REGULATORY REQUIREMENTS

.1 Comply with the following legislation and regulations:

.1 Environmental Protection Act (Canada).
.2 Environmental Protection and Enhancement Act (Alberta).
.3 Occupational Health and Safety Act (Alberta).
.4 Chemical Hazards Regulation (Alberta).
.5 Transportation of Dangerous Goods Act, 1992 (Canada).
.6 Dangerous Goods Transportation and Handling Act (Alberta) and regulations.
.7 Other legislation and regulations which apply to the performance of asbestos control work.

1.9 MONITORING AND INSPECTION BY OWNER

.1 Owner will appoint and pay for services of testing agency to perform the following:

.1 Measure asbestos fibre levels inside and outside asbestos control area prior to commencement of asbestos control work.
.2 Inspect negative air units and HEPA vacuums prior to commencement of asbestos control work.
.3 Monitor air outside asbestos control area and where glovebag removal method is used. Monitor air prior to, during, and after asbestos control work.
.4 Monitor asbestos fibre levels inside asbestos control area prior to removal of barriers.

.2 Testing agency engaged by Owner to perform air monitoring is authorized to identify deficiencies in the asbestos control work and provide site instructions to ensure compliance with Contract requirements.

.3 In the event that airborne asbestos fibres exceed acceptable level, Owner may stop work until corrective actions have been taken and airborne fibres return to acceptable level.

.4 Owner may stop work where he has reasonable cause to believe that:

.1 Fibre levels inside asbestos control area are unacceptable, or
.2 Work conditions and practice may lead to:

.1 Contamination of building with asbestos,

.2 Asbestos exposure to building occupants, or

.3 Release of asbestos fibres into the environment.

1.10 TESTING AND AIR MONITORING BY CONTRACTOR

.1 Appoint and pay for services of a testing agency to perform Dioctylpthalate (DOP) testing on completed installation of negative air units and HEPA vacuums, in accordance with Medical Research Council of Canada, 1980 Guidelines and/or field applications of United States Military Standards Number 282 and U.S. Army Instruction Manual 136-300-175A.

.2 Test prior to commencement of asbestos removal.

.3 Use only negative air units and HEPA vacuums tested and inspected as specified.

.4 Monitor air inside asbestos control area to ensure that fibre levels are within acceptable limits required by Alberta Occupational Health and Safety Act and Chemical Hazards Regulation for type of respirators being used.

1.11 AIRBORNE FIBRE LEVELS

.1 In areas outside asbestos control area and where full containment procedures are not required, airborne fibre levels shall not exceed 0.01 fibers per cubic centimeter of air.

.2 In areas inside asbestos control area where full containment procedures are followed, airborne fibre levels shall not exceed acceptable limits for type of respirators being used.

1.12 PROTECTION OF PERSONNEL

.1 Provide workers with respirators and hooded disposable coveralls conforming to Occupational Health and Safety Regulations for the airborne asbestos fibre levels that are present during asbestos control work.

.2 Do not permit smoking, eating or drinking in work area.

.3 Provide the following to employees involved in asbestos control work:

.1 Written information describing potential health hazards related to exposure to asbestos fibre.

.2 Written instructions describing safe work procedures.

.4 Where full containment procedures are not required, do the following:

.1 Comply with regulatory requirements.

.2 Provide workers with not less than a non-powered half-mask respirator equipped with P100 filters and hooded disposable coveralls. Coveralls shall fit snugly around neck, wrists and ankles.

.3 Allow no one in the removal area during asbestos control work unless wearing disposable coveralls and respirator equipped with P100 filters.

.5 Provide the following safety equipment for Consultant, as required to permit ready and safe access to the work:

.1 Disposable or cloth coveralls.

.2 Rubber boots or easily decontaminated footwear.

.3 Caps.

.4 Eye protection

.5 Gloves.

.6 Hard hats.

.7 Non-powered half mask respirator equipped with P100 filters (minimum).

Part 2 Products

2.1 MATERIAL AND EQUIPMENT

.1 Asbestos Sealer: to CAN/CGSB-1.205-94, Sealer for Application to Asbestos-Fibre-Releasing Materials, Class A - water-based, for spray application, and as follows:

.1 Type 1 – Penetrating. Acceptable products: American Coating “CC-22P”, Better Working Environments “BWE 3000”, Certified Technologies “Undercoat 2050” Childers “Chil-Abate CP-210”, Fiberlock Technologies “ABC”, Foster “32-20 (yellow), 32-21(blue), 32-22(undyed)”, International Protective Coatings “Serpilock, Serpiflex Shield”.

.2 Type 2 - Surface Film Forming. Acceptable products: American Coating “CC-2B”, Certified Technologies “Overcoat 2000”, Childers “Chil-Bridge CP-211”, Fiberlock Technologies “ABC”, Foster “32-32”, International Protective Coatings “Serpiflex Shield”.

.2 Vacuums: HEPA filtered wet/dry type, with accessories adequate to perform removal and cleanup work.

2.2 ASBESTOS DISPOSAL CONTAINERS

.1 Plastic Bags: to CAN/CGSB-43.150, minimum 150 micrometer thick sheet polyethylene. Bag seams shall be sufficiently strong to resist pressure and shocks that occur under normal conditions of transport. Designed and manufactured to contain a maximum net mass of 50kg.

.2 Drums: to CAN/CGSB-43.150, sturdy non-reusable, steel (1A2), aluminum (1B2), or plastic (1H2), with tight fitting lids.

.3 Sheet Polyethylene: two separate layers, minimum 150 micrometer thick, each layer sealed with water-resistant plastic duct tape.

.4 Label containers with labels stating "CONTAINS ASBESTOS, CANCER HAZARD, AVOID BREATHING DUST".

2.3 WARNING SIGNS

.1 Provide warning signs which state that:

.1 Asbestos is present in the area.

.2 Access to the area is prohibited, except to authorized personnel.

.3 Drinking, eating and smoking are prohibited in the area.

.2 Obtain Consultant’s approval of warning sign wording, legibility and location.

Part 3 Execution

3.1 PREPARATION

.1 Asbestos control work may commence only after the following have been completed:

.1 Existing property, including non-removable equipment and furnishings, surfaces and finishes, have been protected from damage and contamination due to asbestos control work.

.2 HVAC system has been deactivated and/or isolated and sealed to prevent asbestos fibres from entering the system.

.3 Electrical system has been isolated.

.4 Barriers are in place.

.5 Decontamination facilities are in place and operational.

.6 Negative pressure ventilation system has been installed and certified acceptable by testing agency.

.7 Warning signs have been placed around perimeter of asbestos control area and at each potential entrance to the area.

.8 Consultant has inspected and approved preparations.

.2 Asbestos control work may commence only after the following have been completed:

.1 Existing property, including non-removable equipment and furnishings, surfaces and finishes, have been protected from damage and contamination due to asbestos control work.

.2 Barriers are in place and work area has been isolated.

.3 Warning signs have been placed around perimeter of asbestos control area and at each potential entrance to the area.

.4 Consultant has inspected and approved preparations.

3.2 ASBESTOS REMOVAL

.1 Refer to Section 02 82 13 for asbestos removal requirements.

.2 Refer to Section 02 82 13 for asbestos encapsulation requirements.

3.3 PREPARATION FOR ASBESTOS DISPOSAL

.1 Prepare contaminant and contaminated materials for disposal as follows:

.1 Place in double bagged plastic asbestos disposal bags or inside disposable drums with tight fitting lids.

.2 Wrap bulk materials that do not lend themselves to disposal in plastic bags or drums, in sheet polyethylene. (2 separately sealed layers)

.3 The resulting package must be constructed, filled and closed so that, under normal conditions of handling and transport, there will be no discharge, emission or escape of the dangerous goods form the package or small container that could constitute a danger to public safety.

.2 Transfer asbestos waste containers and normal construction waste from asbestos control area for disposal, in accordance with procedures described in the following documents.

.1 Alberta Environmental Protection document entitled “Guidelines for the Disposal of Asbestos Waste”.

.2 Alberta Employment, Immigration and Industry document entitled “Asbestos Abatement Manual”, current edition.

.3 Section 02 82 33 – Asbestos Removal.

.4 Where more than one document addresses an issue, the most stringent requirements shall apply.

.3 Treat contaminated water as asbestos waste.

3.4 DISPOSAL OF NORMAL CONSTRUCTION WASTE

.1 This article applies to materials not readily prepared for asbestos disposal as specified, and being capable of thorough cleaning, for example, bulky mechanical equipment.

.2 Clean materials until free of visible asbestos, wash, and dip in or spray with asbestos sealer.

.3 Dispose of as normal construction waste.

3.5 TRANSPORTATION AND PERMANENT DISPOSAL OF ASBESTOS WASTE

.1 Transport asbestos waste in accordance with Alberta and Federal legislation and regulations.

.2 Ensure that all materials are properly packaged and labeled prior to transportation. Each container must be marked in accordance with the Dangerous Goods Transportation and Handling Act showing the shipping name (Blue or Brown Asbestos) (White Asbestos) and product identification number (UN2212) (UN2590).

.3 Transport hazardous waste materials in properly placarded vehicles.

.4 Transport asbestos waste in a manner which will prevent asbestos fibres from becoming airborne.

.5 Each load shall be accompanied by a properly completed manifest satisfactory to the authority having jurisdiction.

.6 Dispose of asbestos waste in a supervised, approved sanitary landfill site.

.7 Make arrangements with operator of landfill site in advance to receive asbestos waste material.

.8 In event of leakage or spillage enroute, repackage material before continuing transport to landfill.

.9 If spill, emission or discharge of waste asbestos is in excess of 50 kg from the transport unit, immediately report the incident to the local police.

.10 Place asbestos waste containers intact in excavated area. Do not dump or throw containers from truck. Repackage contents of containers that have broken open, in accordance with requirements for preparation for asbestos disposal.

.11 Arrange for asbestos waste to be covered with soil.

.12 Provide the Minster with a copy of each waste manifest once asbestos waste has been disposed of at a supervised, approved landfill site.

3.6 WORKER DECONTAMINATION

.1 Workers shall follow decontamination procedures as outlined in the "Manual of Safe Practice" and as specified.

.2 Prior to leaving area where asbestos has been removed by method not requiring full containment, vacuum using HEPA filtered vacuum or wet wipe in coveralls. Dispose of coveralls and wiping rags into polyethylene bags as asbestos waste.

.3 Immediately upon leaving area where asbestos has been removed by method not requiring full containment, perform the following:

.1 Proceed to nearest shower outside work area and, with respirator in place, shower head and face prior to removal of respirator. If a shower is not available, wash head thoroughly, including exterior of respirator, prior to removing respirator.

.2 Dispose of respirator filters as asbestos waste.

3.7 DAILY CLEANING

.1 Progressively containerize contaminant and contaminated material as removal work progresses. Do not permit asbestos waste to accumulate.

.2 Keep contaminant and contaminated material damp to minimize generation of airborne asbestos fibres.

.3 Remove asbestos waste from asbestos control area at least once per day.

.4 Regularly check, clean and replace filters as necessary.

3.8 FINAL CLEANING

.1 Upon completion of asbestos control work, perform the following:

.1 Remove asbestos waste from work site.

.2 Vacuum and wash contaminated tools and equipment.

.3 Dispose of non-reusable materials and contaminated materials as asbestos waste.

.4 Clean site to original condition.

.5 Make good any damage resulting from the asbestos control work, to the satisfaction of the Consultant.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 00 – Rough Carpentry

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A307-12, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA-S16-09, Design of Steel Structures, Includes Update No. 1 (2010), Update No. 2 (2010), Update No. 3 (2013).

.3 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel, Includes Update No. 3 (2011), Update No. 5 (2012), Update No. (2013).

.4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014).

.4 The Environmental Choice Program

.1 CCD-047a-98, Paints, Surface Coatings.

.2 CCD-048-98, Surface Coatings - Recycled Water-borne.

.5 National Association of Architectural Metal Manufacturers (NAAMM)

.1 NAAMM AMP 555-92, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and data sheets.

.2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:

.1 Finishes, coatings, primers and paints.

.2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:

.1 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

.2 For items where design is delegated to fabricator, provide shop drawings signed and sealed by the professional engineer registered in Province of Work.

1.4 QUALITY ASSURANCE

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

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

.3 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 555.

.4 Perform Work to the highest standard of modern shop and field practice, by personnel experienced in this Work. Accurately fit joints and intersecting members in true planes with adequate fastening. Build and erect the Work plumb, true, square, straight, level, accurate to the sizes shown, and free from distortion or defects.

.5 Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

.6 Welding: Qualify procedures and personnel according to the following:

.1 Welders shall be qualified by Canadian Welding Bureau for classification of work being performed.

.2 The fabricator shall be certified to CSA W47.1, Division 1 or 2.1.

.3 Do welding inspection to CSA W178.

.4 Resistance welding: to CSA W55.3.

.5 Fusion welding: to CSA W59.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Exercise due care in storing, handling and erecting all materials and support all materials properly at all times so that no piece will be bent, twisted or otherwise damage structurally or visibly.

.2 Correct damaged material and where the Consultant deems damage irreparable, replace the affected items at no additional expense to the Consultant or Departmental Representative.

.3 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed.

.4 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.

1.7 JOB CONDITIONS

.1 Coordinate this Work with the remainder of the Work and exercise the necessary scheduling to ensure that all Work is carried out and all items incorporated during the appropriate construction phase.

.2 Provide instructions and drawings to other trades for setting bearing plates, anchors blots, and other members that are built in to work of other trades.

.3 Protect other Sections of the Work from damage by this Section of the Work.

Part 2 Products

2.1 MATERIALS

.1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 300W.

.2 Hollow Structural Sections: In accordance with CAN/CSA G40.20/G40.21, Grade 350W, Class C.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A307.

2.2 FABRICATION

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

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

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications to provide corrosion protection in accordance with CAN-S16.

.5 Welding is to conform to CSA W59 and the fabricator certified to CSA W47.1. Include for welding inspection in the Contract.

.6 File or grind all exposed welds smooth and flush. Repair or fill all pits, cracks and holes. Grind and polish all handrails to a smooth, even surface. Smooth all inside corners, returns.

.7 Insulate when necessary to prevent electrolysis due to metal to metal contact or metal to masonry or concrete contact. Use bituminous paint or other approved method.

.8 Provide fastenings, including anchor bolts, bolts, lag screws, expansion bolts, straps, brackets, etc. required for the fabrication and erection of work of this Section.

2.3 FINISHES

.1 Prior to priming steel, prepare all surfaces in conformance with SSPC SP-3 – Power Tool Cleaning for non-exposed locations and SSPC SP-5 – White-metal

Blast Cleaning for exposed architectural finished locations. Adjust blast grit to suit primer coat thickness,

.2 Shop coat primer: to CAN/CGSB-1.40.

.3 Paint: Prepare the Work and paint in accordance with CAN/CSA-S16, primed ready for site finish. Leave surfaces to be welded unpainted.

Part 3 Execution

3.1 ERECTION

.1 Install Work in accordance with manufacturer's/fabricator's written instructions and Contract Documents.

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

.3 Supply finished items to be built-in to those trades along with instructions for proper installation.

.4 Fasteners to draw adjoining sections together in proper, true alignment, and are capable of field adjustment.

.5 All fasteners, mountings to be non-loosening.

.6 Install all Work to true, straight lines, accurate to profile, all properly aligned.

.7 Isolate dissimilar metals in a manner approved by the Consultant to prevent electrolytic action or corrosion.

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

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

.10 Make field connections with high tensile bolts to CSA-S16.1 and weld to prevent loosening.

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

3.2 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

- .1 ANSI/NPA A208.1-2009, Particleboard.
- .2 ANSI A208.2-2009, Medium Density Fibreboard (MDF) for Interior Applications.

.2 Alberta Roofing Contractors' Association, (ARCA):

- .1 Manual on Good Roofing Practice and Accepted Roofing Systems.

.3 American Society for Testing and Materials International (ASTM)

- .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- .2 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.
- .3 ASTM C578-14, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .4 ASTM C954-11, 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
- .5 ASTM C1289-14, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- .6 ASTM D1761-12, Standard Test Methods for Mechanical Fasteners in Wood.
- .7 ASTM D5055-13e1, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
- .8 ASTM D5456-14a, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .9 ASTM E1333-10, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.

.4 American Wood Preservers Association (AWPA):

- .1 AWPA Book of Standards, 2012

.5 Canadian Standards Association (CSA International)

- .1 CSA A123.2-03 (R2013), Asphalt-Coated Roofing Sheets.
- .2 CAN/CSA-A247-M86 (R1996), Insulating Fiberboard.
- .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .5 CAN/CSA O80 Series-08, Wood Preservation
- .6 CSA O112 Series-M1977 (R2006), CSA Standards for Wood Adhesives.
- .7 CSA O141-05 (R2009), Softwood Lumber.
- .8 CSA O151-09, Canadian Softwood Plywood.
- .9 CSA O153-M1980(R2008), Poplar Plywood.

.10 CAN/CSA-O325-07, Construction Sheathing.

.6 National Lumber Grading Association (NLGA):

.1 NLGA SPS2-2010, Special Products Standards on Machine Stress-Rated Lumber.

.2 Standard Grading Rules for Canadian Lumber 2010.

.7 NLGA Canadian Lumber Grading Rules Forest Stewardship Council (FSC)

.1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

.2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.3

.3 FSC Accredited Certified Bodies.

.8 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1113-04, Architectural Coatings.

.2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.9 Truss Design and Procedures for Light Metal Connected Wood Trusses, Truss Plate Institute of Canada.

.10 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S770-09, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 DEFINITIONS

.1 For the purpose of this project the following definitions shall apply:

.1 Structural Light Framing: All horizontal and vertical load bearing framing including members indicated as “Studs” on the drawings shall be considered to be No. 2 Grade and better and shall be used throughout unless prior approval is provided by the Departmental Representative.

.2 Stud Framing: Vertical framing members of non-load bearing wall systems may be considered as No. 3 or Stud Grade and may only be used where the Departmental Representative gives prior approval. Use of No. 3 and Stud Grade framing material will not be allowed for any horizontal applications.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer’s printed product literature, specifications and data sheets.

.2 Submit MSDS sheets or official manufacturer literature stating no urea-formaldehyde was used in the manufacturing of composite wood.

1.4 QUALITY ASSURANCE

.1 Lumber shall be graded and stamped by an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver wood products bundled or crated to provide adequate protection during transit. Inspect wood products for damage upon delivery and remove and replace damaged materials.

.2 Store materials a minimum of 150 mm off the ground on blocking. Keep materials under cover and dry. Provide for air circulation within and around stacks and under temporary coverings.

.3 Protect sheet materials to prevent breaking of corners and damage to surfaces.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 LUMBER

.1 Lumber: Stud Grade to CAN/CSA-O141, softwood, S-P-F, S4S, graded and stamped in accordance with National Lumber Grading Association (NLGA) Standard Grading Rules for Canadian Lumber and as follows:

.1 Moisture Content: maximum 19% at time of installation.

.2 Maximum moisture content when used for attachment of drywall: 16%.

.3 Meeting requirements of the Alberta Building Code.

.4 Grade:No. 1 or better.

.5 Meeting requirements of the Alberta Building Code.

2.2 PANEL MATERIALS

.1 Sheathing for vertical and horizontal locations as indicated on drawings.:

.1 Plywood: Douglas Fir (DFP) or Canadian Softwood (CSP), Sheathing Grade, to CSA O121 or O151, thickness as indicated on drawings.

2.3 MISCELLANEOUS LUMBER

.1 Provide lumber for support or attachment of other construction, including furring, blocking, nailing strips, ground, rough bucks, cants, curbs, fascia, backing sleepers, and similar members.

.2 Fabricate miscellaneous lumber from dimension lumber of sizes indicated, and into shapes shown on drawings.

.3 Moisture Content: 19% maximum for lumber items not specified to receive wood preservative treatment.

.4 Grade: for dimension lumber sizes provide No. 2 or Standard grade lumber per NLGA. For board-sized lumber, provide sheathing grade, S2S.

2.4 WOOD PRESERVATIVE

.1 Where lumber or plywood is indicated as preservative treated or is specified to be treated, treated in accordance with CAN/CSA O80.9M and AWPA.

.2 Wood preservatives containing arsenic or chromium are not permitted.

.3 Pressure treat above ground items with waterborne preservatives to minimum retention of 4.0 kg/m^3. After treatment, kiln-dry lumber and plywood to maximum moisture content of 19% and 15% respectively. Treat indicated items and the following:

.1 Wood cants, nailing strips, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapour barriers, and waterproofing.

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

.3 Wood framing members less than 460 mm above grade.

.4 Wood floor plates installed over concrete slabs directly in contact with earth.

.4 Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to minimum of 6.4kg/m^3

.5 Fire-Retardant Treatment: to CAN/SCA O80.9M, CAN/CSA O80.20M and CAN/CSA O80.27M, pressure impregnated, and as follows:

.1 Flame Spread Classification: FSC 25 maximum.

.2 Smoke developed of not more than: 75.

.6 Complete fabrication of treated items before treatment where possible. If cut after treatment apply field treatment to cut surfaces.

.7 Wood Preservatives: Maximum allowable VOC limit 350 g/L in accordance with SCAQMD Rule #1113 - Architectural Coatings.

2.5 ACCESSORIES

.1 Sealants: in accordance with Section 07 92 00 – Sealants.

.1 Maximum allowable VOC limit 250 g/L in accordance with SCAQMD Rule 1168.

.2 General purpose adhesive: to CSA O112 Series.

.1 Maximum allowable VOC limit 70 g/L in accordance with SCAQMD Rule 1168.

.3 Nails, spikes and staples: to CSA B111, hot dipped galvanized for exterior work and pressure preservative and fire retardant treated materials.

.4 Surface Applied Wood Preservative:

.1 Containing minimum 5% clear pentachlorophenol in accordance with CAN/CSA-O80 Series-M89.

.2 Apply minimum of 2 coats applied in accordance with manufacturers written instructions.

.5 Rough Hardware (bolts, nuts, washers, etc.): Hot dip galvanized in conformity to CSA G164 or Grade A low carbon steel, conforming to ASTM A307.

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

.7 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.

.8 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Departmental Representative.

.9 Expanding foam sealant: single component polyurethane to CAN/ULC-S710.1.

2.6 FASTENER FINISHES

.1 Galvanizing: to CAN/CSA-G164, use galvanized fasteners for exterior work, pressure-preservative, and fire-retardant treated lumber.

Part 3 Execution

3.1 INSTALLATION

.1 Comply with requirements of ABC 2006 Part 9 supplemented by following paragraphs.

.2 Install members true to line, levels and elevations, square and plumb.

.3 Construct continuous members from pieces of longest practical length.

.4 Install spanning members with "crown-edge" up.

.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 Install blocking at locations indicated to support washroom accessories.

.7 Install wall sheathing in accordance with manufacturer's printed instructions.

.8 Install roof sheathing in accordance with requirements of ABC.

.9 Install furring and blocking as required to space-out and facings, and other work as required.

.10 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.

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

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

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

.13 Install sleepers as indicated.

.14 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

3.2 ERECTION

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

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

.3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C167-09, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.

.2 ASTM C553-13, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.3 ASTM C665-12, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.4 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

.2 Canadian Gas Association (CGA)

.1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code, Includes Update No. 1 (2010).

.2 CAN/CGA-B149.2-10, Propane Storage and Handling Code.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Standard Method of Test For Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.3 CAN/ULC-S604-M91, Standard for Factory Built Type A Chimneys.

.4 CAN/ULC-S702-09-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1 (January 2012).

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and data sheet.

.2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for sealants. Indicate VOC content.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

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

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver insulation and accessories in original unopened packaging or cartons bearing manufacturer's seals and labels.

.2 Store materials under cover on raised platforms, away from moisture. Keep dry at all times.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 BATT INSULATION

.1 Fibrous Mineral Wool Insulation: Un-faced, preformed mineral slag fibrous insulation in accordance with CAN/ULC S702 and as follows:

.1 Type: 1

.2 Thermal Resistance: nominal RSI of 0.67/25 mm.

.3 Combustion Characteristics: non-combustible in accordance with CAN/ULC S114.

.4 Flamespread: less than 5 in accordance with CAN/ULC S102.

.5 Density: 32 kg/m^3.

.6 Thickness: as required to fill insulated spaces.

2.2 ACCESSORIES

.1 Insulation clips:

.1 Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

.2 Nails: galvanized steel, length to suit insulation plus 25 mm, to ASTM F1667.

.3 Staples: 12 mm minimum leg.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 PREPARATION

.1 Verify all in-wall construction is complete before beginning installation.

.2 Install insulation after building substrate materials are dry.

.3 Ensure substrate materials are properly installed and complete before beginning installation.

3.3 INSTALLATION

.1 Install batts between framing members, structural components and other items snug and tight.

.2 Cut and trim batts neatly to fit spaces. Use batts free from ripped or damaged back and edges.

.3 Do not compress insulation to fit into spaces.

.4 Install batt insulation where indicated with continuous vapour retarder on the warm side of the insulation in accordance with ASTM C1320.

.5 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

.6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 Type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.

.7 Fill stud space of exterior framed walls with insulation full depth of stud only where no insulation/vapour retardant indicated on exterior face of stud walls.

.8 Hold insulation in position with clips, wires or as recommended by manufacturer when insulation is installed in horizontal locations.

.9 Do not enclose insulation until it has been reviewed by Consultant.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 INTENT

.1 Foam-in-place insulation around protrusions through the exterior wall envelope and juncture of different cladding materials.

1.2 REFERENCES

.1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)

.2 Green Seal Environmental Standards

.1 Standard GC-03-97, Anti-Corrosive Paints.

.2 Standard GS-11-10, Paints and Coatings.

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

.1 Material Safety Data Sheets (MSDS).

.4 South Coast Air Quality Management District (SCAQMD), California State SCAQMD Rule 1113-06, Architectural Coatings.

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.3 CAN/ULC-S705.1-01-AM3, Amendment 3 to Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density,-Material –Specification, Includes Amendments 1,2.

.4 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.

.2 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Test reports: submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installers: Use companies that are members and licensed CUFCA having trained and certified installers in accordance with CAN/ULC S705.2 and CUFCA requriements.

.2 Manufacturer: Obtain air and vapour seal materials from a single manufacturer regularly engaged in manufacturing the products specified in this Section.

.2 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

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

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.

1.7 SITE CONDITIONS

.1 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

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

.3 Ensure temperature is maintained throughout the curing period.

Part 2 Products

2.1 MATERIALS

.1 Insulation: One component rigid urethane foam with the following physical properties:

Density (ASTM D1622):	30.3 kg/m³
Compressive Strength (ASTM D1621):	57.5 kPa
Compressive Modulus (10% deflection):	848 kPa
Tensile Strength (ASTM D1623):	133.5 kPa
Flatwise Shear (ASTM C273):	58.5 kPa
Thermal Resistance:	1.41 RSI/25 mm thickness
Water Absorption (ASTM D2842):	3.0 kg/H20/m²
Water Vapour Transmission (ASTM E96):	2.327 perms

.2 Thermal Barrier: spray applied fire retardant overcoat meeting applicable requirements of the Alberta Building Code for thermal barrier of foamed plastic.

Part 3 Execution

3.1 SURFACE PREPARATION/EXISTING CONDITIONS

.1 Clean spaces that are to receive insulation, of dirt, dust, grease, loose material or other foreign matter that may inhibit adhesion.

.2 Provide sufficient ventilation during and until insulation has cured, to ensure safe working conditions. Introduce fresh air and exhaust air continuously during the 24 hour period after application.

.3 Protect adjacent surfaces from overspray and dusting.

.4 Prior to application, slightly moisten surfaces to which foam in place insulation is being applied, to accelerate curing.

.5 Temporarily brace frames as may be required to prevent possible bowing of frames due to over expansion of the foam-in-place insulation.

3.2 INSTALLATION/AROUND PROTRUSIONS THROUGH AIR SEAL

.1 Install foam-in-place insulation around all protrusions through the exterior building envelope to achieve and maintain continuity of air/vapour seal.

3.3 CLEANING

.1 Cut back excess foam-in-place insulation once cured, flush with surrounding surfaces, or recess back for application of sealant as specified in Section 07 92 00.

.2 Upon completion of foam-in-place insulation work, clean adjacent surfaces of overspray and dusting to the satisfaction of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

- .1 ASTM E96/E96M-13, Standard Test Methods for Water Vapor Transmission of Materials.
- .2 ASTM C726-12, Standard Specification for Mineral Wool Roof Insulation Board.
- .3 ASTM C728-13, Standard Specification for Perlite Thermal Insulation Board.
- .4 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .5 ASTM D41/D41M-11, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- .6 ASTM D6162-00a (2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
- .7 ASTM D6163-00 (2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
- .8 ASTM D6164/D6164M-11, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.3 Canadian Roofing Contractors Association (CRCA)

- .1 CRCA Roofing Specifications Manual.

.4 Canadian Standards Association (CSA International)

- .1 CSA A123.21-14, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems, Includes Update No. 1 (2010).
- .2 CSA O121-08(R2013), Douglas Fir Plywood, Includes Update No. 1 (2013).
- .3 CSA O151-09, Canadian Softwood Plywood.

.5 Department of Justice Canada (Jus).

- .1 Canadian Environmental Protection Act, 1999 (CEPA).

.6 Factory Mutual (FM Global)

- .1 FM Approvals - Roofing Products.

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

- .1 Material Safety Data Sheets (MSDS).

.8 Underwriters Laboratories' of Canada (ULC)

- .1 CAN/ULC S107-10, Methods of Fire Tests of Roof Coverings.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 ULC-S702.2-10, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

.4 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.5 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning work of this Section, with Roof Consultant, Contractor, Departmental Representative, installer, manufacturer's representative in accordance with Section 01 31 19 – Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Provide copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements and 01 35 43 - Environmental Procedures, and indicate VOC content for:

.1 Primers

.2 Vapour retarder membrane

.3 Sealers

.4 Adhesives

.5 Insulation

.6 Base and cap sheet

.2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:

.1 Indicate flashing, control joints, tapered insulation details.

.2 Provide layout for tapered insulation.

.3 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.4 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and membrane with specification requirements.

.5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.6 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.

.7 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.4 QUALITY ASSURANCE

.1 Obtain roofing membrane materials through one source from a single manufacturer.

.2 Installer Qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by membrane manufacturer.

.3 Roofing and sheet metal work shall be performed in conformance with roofing manufacturer's written recommendations using materials in accordance with CAN/ULC S107.

.4 Conform to Roofing Application Standards Manual as published by ARCA.

.5 Work shall be executed by an applicator approved by the manufacturer.

1.5 FIRE PROTECTION

.1 Comply with safety measures described in manufacturer's written installation requirements, requirements of insurance companies and other requirements of the Authorities Having Jurisdiction.

.2 Fire Extinguishers, located within six (6) meters of each roofing torch, ULC /labelled for ABC protection.

.3 At the end of each workday, use a heat detector gun to spot any smouldering or concealed hot spots. Job planning must be organized to ensure workers are still on location at least two hours after torch application.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store rolls of membrane in upright position. Store membrane rolls with selvage edge up.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5 degrees C minimum.

.7 Store insulation protected from weather, daylight and deleterious materials.

.8 Do not store materials on roof in concentrations that exceed design live load.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not perform roofing work when air temperature, including wind chill, falls below the membrane manufacturer's recommended limit.

.2 Do not apply roofing materials to a damp, frozen or unsuitable surface.

.3 Do not expose roofing materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during the same day.

1.9 WARRANTY

.1 Roofing Membrane Manufacturer: Provide manufacturer's warranty stating that they will repair or replace defective roofing (including labour) and base flashing materials that do not remain watertight, that splits, tears, or separates at the seams or from the substrate within the specified warranty period and as follows:

.1 Warranty Period: 15 years leak free, no dollar limit (NDL) Warranty, starting from Substantial Performance for the Project including labour, material, and workmanship.

.2 Name of Warrantee: Warrantor shall issue a written and signed warranty identifying the Departmental Representative name as the warrantee, and stating that executed work will remain in place and be free of any defects in materials and workmanship for the stated warranty period.

Part 2 Products

2.1 PERFORMANCE CRITERIA

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

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 DECK COVERING

.1 Glass Mat Faced Roof Boards: to ASTM C1177/C1177M for manufacturing and ASTM D3272 for mould resistance, standard, mould resistant, thickness as indicated on drawings.

.1 Surface Burning Characteristics: In accordance with CAN/ULC S102.

.1 Flame Spread: 0

.2 Smoke Developed: 0

.2 Long Edges: Square.

.3 Location: Roof substrates over wood decks.

.2 Sheathing board attachment to deck: Corrosion-resistant, self-tapping screws and plates, capable of withstanding specified windloads (refer to Quality Assurance requirements).

.1 Minimum Fastener Properties:

.1 /Nominal 8 mm (0.33") diameter fastener with oversized head.

.2 Buttress Threads: 12 threads per inch.

.3 Pull-out value in 22 gauge Grade E steel deck: 4.2 kN.

.4 Typical Static Back-Out: 5.1 N-m.

.5 Length to be sufficient to penetrate wood deck by minimum recommended length but not penetrate underside of deck.

2.3 PRIMER

.1 Primer comprised of elastomeric bitumen, volatile solvents and adhesive enhancing additives as recommended by membrane roofing manufacturer to suit substrate and installation conditions.

2.4 VAPOUR RETARDER

.1 Premanufactured Self Adhesive Air/Vapour Barrier: Self-adhesive vapour barrier membrane composed of SBS modified bitumen with thermoplastic polymers and high density polyethylene film with polyethylene film on top and release film underside and as follows:

.1 Thickness: Minimum 0.8 mm.

.2 Width: 1140 mm.

.3 Cold Bending: -35°C

.4 Static Puncture: 400 N.

.5 Membrane Breaking Strength (MPa): MD=75, XD=98.

.6 Water Vapour Permeance: 0.92 ng/Pa•s•m^2 to ASTM E96.

.2 Vapour retarder continuity strip: SBS membrane with non-woven polyester reinforcement, glass grid and elastomeric bitumen. Sanded upper surface; underside self-adhesive, compatible with wall and roof air/vapour retarder membranes as recommended by accepted membrane manufacturers below.

2.5 INSULATION

.1 Primary Flat Insulation: closed-cell polyisocyanurate foam core laminated to heavy non-asphaltic glass fibre reinforced facers; 25 mm thickness of largest panels practical, having square edges, minimum LTTR RSI 1.04/25 mm; conforming to ULC S704, Type 3, Class 2, to a tolerance not exceeding 3 mm from nominal size in any dimension, and as follows:

.2 Secondary Flat and Sloped Insulation: Polystyrene board insulation conforming to CAN/ULC S701, Type 2, minimum RSI 0.70 per 25 mm, compressive strength 100 kPa, thickness as indicated on drawings.

.3 Sloped insulation: sloped to a minimum of 1% perpendicular from edge of roof to a minimum thickness of 50 mm.

.4 Total roof value 5.28 RSI (R30).

2.6 MEMBRANE

.1 Composite Cover Board: Asphaltic-support board and factory applied base sheet:

.1 Description: SBS modified base sheet membrane and polyester reinforcement, factory applied to a semi-rigid asphaltic board. The top

surface is covered with sane. The membrane side lap is 60% self-adhesive and 40% covered with a poly film that is heat sealed.

.1 Board size: 910 mm x 2440 mm x 6.8 mm thick

.2 In conformance with: CGSB 37.56-M

.3 Properties:

		MD	XMD
.1	Strain Energy (kN/m)	9	7
.2	Breaking Strength (N/50 mm)	17	12.5
.3	Ultimate Elongation (%)	60	65
.4	Tear Resistance (N)	60	
.5	Static Puncture Resistance (N)	400	
.6	Dimensional Stability (%)	-0.4	0.3
.7	Plastic Flow (^{o}C)	≥ 115	
.8	Cold Bending (at –30°C)	No Cracking	
.9	Lap Joint Strength (kN/m)	Pass > 4kN/m	

.2 Membrane base sheet flashing (stripping):

.1 Primer: Manufacturer's recommended elastomeric bitumen or synthetic rubber blend, volatile solvents, adhesive enhancing additives and resins used to prime substrate to enhance the adhesion of self-adhesive membranes suitable for application temperatures.

.2 Roofing membrane with non-woven polyester reinforcement and glass grid and elastomeric bitumen. Top face covered with thermofusible plastic film, underside self-adhesive and protected by silicone release paper in accordance with CGSB 37-GP-56M type 2, class C, grade 1.

.3 Components:

.1 Reinforcement: Non-woven polyester and glass grid.

.2 Elastomeric bitumen: Mix of selected bitumen and SBS polymer.

.3 Mark top face with lines to ensure proper roll alignment.

.4 Characteristics:

.1 Cold bending at minimum -25°C: No cracking

.2 Softening point: ≥ 110°C

.3 Reinforcing weight: minimum 160 g/m^2

.4 Membrane Thickness: minimum 2.5 mm

2.7 ROOF MEMBRANE CAP SHEET

.1 Field area and flashing cap sheet membrane: to CAN/CGSB 37.56M, composed of non-woven polyester and SBS modified bitumen and as follows:

.1 Thickness: 4 mm

.2 Application: Torch applied

.3 Underface: Thermofusible plastic film

.4 Granular colour: to be selected by Departmental Representative from manufacturer's standard range.

.5 System Properties:

		MD	XD
.1	Strain Energy (kN/m)	10	10
.2	Breaking Strength (kN/m)	18	16

.3	Ultimate Elongation (%)	60	65
.4	Dimensional Stability (%)	-0.8	-0.2

.5 Tear Resistance (N): 75

.6 Static Puncture (N): 420

.7 Plastic Flow: 110 degrees C

.8 Cold Bending (initial and 90 days at 70 degrees C): -30 degrees C

2.8 ADHESIVE

.1 Insulation Adhesive: Manufacturers standard low rise foam adhesives specifically formulated for installation of plastic insulation to roofing materials:

2.9 ACCESSORIES

.1 Perimeter Fire Seal: SBS modified bitumen, minimum 60 gm/m^2 glass fleece reinforced, self adhering membrane having sanded top face, cut into strips minimum 150 mm wide x nominal 1.5 mm thick.

.2 Walkways:

.1 Consisting of one additional ply of cap sheet membrane. Colour to be different from field membrane as selected by Departmental Representative.

.3 Flashing and sheet metal in accordance with section 07 62 00 – Sheet Metal Flashing and Trim.

.4 Liquid Membrane Flashing: waterproofing one-component polyurethane/bitumen resin and as follows:

.1 Performance Characteristics:

.1 Density at 25°C (g/l): 1070

.2 Solid content (%): 80

.3 Flash point (^{o}C): 2.5

.4 Softening point (^{o}C): 150

.5 Roof Drain: 360 mm diameter epoxy coated cast iron roof drain with deep sump, wide serrated flashing flange, underdeck flashing clamp device with integral gravel stop, and self-locking leak-free cast metal debris dome strainer. Match existing rain water leader dimensions for pipe sizing.

.6 Waterproofing Mastic: Black, solvent based mastic containing SBS modified bitumen, fibres and mineral fillers.

.7 Roof drain pans, vent stack covers and other roof penetration flashings: premanufactured, stainless steel construction, purpose-made to suit application and location, designed to tie-in to SBS modified membrane roofing systems.

2.10 PIPE SUPPORTS

.1 Premanufactured Pipe Supports: fabricated from 100% recycled rubber with 2.7 mm thickness galvanized steel frame, 150 mm wide x 100 mm tall x length to suit installation; including fasteners, bridge components, and angled supports as required for a complete installation and having the following accessories:

.1 Pipe and Conduit Support: Galvanized pipe clamp sized to suit gas pipe in accordance with manufacturers instruction's.

.2 Multi-Pipe and Conduit Support: Galvanized pipe support system size and number to suit pipes being supported in accordance with manufacturer's instructions.

.3 Extendable Height Support: Galvanized steel pipe extensions to suit installation in accordance with manufacturer's instructions.

Part 3 Execution

3.1 QUALITY OF WORK

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and ARCA Roofing Manual.

.2 Do priming in accordance with manufacturers written recommendations.

.3 The interface of the walls and roof assemblies will be fitted with durable rigid material plywood providing connection point for continuity of air barrier.

.4 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.2 EXAMINATION OF ROOF DECKS

.1 Verification of Conditions:

.1 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed. The start of roofing work will mean roofing conditions are acceptable for work completion.

.2 Evaluation and Assessment:

.1 Prior to beginning of work ensure:

.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

.2 Curbs have been built.

.3 Roof drains have been installed at proper elevations relative to finished roof surface.

.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used. Roofing Contractor shall assume full responsibility for damage.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking shall be treated with rust proofing or galvanization.

3.4 DECK SHEATHING

.1 Mechanically fasten to deck Glass Mat Gypsum Board with screws to wood deck surface, spaced 400 mm on centre each way. Fasteners shall not penetrate underside of deck boards.

.2 Place with long axis of each sheet transverse to wood deck boards, with end joints staggered and fully supported.

3.5 PRIMING DECK

.1 Apply primer to new deck sheathing at the rate recommended by manufacturer.

.2 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.

.3 Cover primed surfaces with new vapour retarder within time limits recommended by roofing membrane system manufacturer.

3.6 VAPOUR RETARDER INSTALLATION

.1 Install self adhering air/vapour barrier membrane by unrolling air/vapour barrier membrane onto substrate aligned with substrate materials starting at bottom of slope without removing silicone release sheet, and as follows:

.1 Peel back one end of silicone release sheet and adhere membrane to substrate; peel remaining release sheet at a 45° angle to avoid wrinkles in membrane.

.2 Cut roll and start again where membrane is not properly aligned to deck flutes; re-align membrane and overlap end of misaligned piece by 150 mm.

.3 Overlap adjacent membranes by 75 mm; overlap end laps by 150 mm; stagger end laps by 300 mm; place thin sheet of metal under end lap of membrane to provide structural support to lapped membranes.

.2 Overlap roof air/vapour barrier to wall air/vapour barrier using compatible continuity strip to provide continuity of building envelope.

3.7 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

.1 Insulation: fully adhered, adhesive application:

.1 Adhere insulation to laminated vapour retarder using manufacturers recommended adhesive.

.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.3 Cut end pieces to suit.

.4 Apply adhesive in continuous ribbons at 300 mm on centre in the field, 150 mm at the perimeters and 100 mm in the corners..

.2 Tapered insulation application:

.1 Install tapered insulation as first insulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

.3 Perimeter Fire Seal Application

.1 Apply primer and perimeter fire seal to roof perimeter and curb substrates prior to applying base sheet materials. Apply fire seal to vertical joints in parapet or curb sheathing, and at vertical corners.

.2 Extend fire seal minimum 50 mm up parapet faces and extend fire seal minimum 75 mm onto adjacent substrates. Ensure air bubbles and fish mouths are removed.

.3 Install perimeter fire seal to act as temporary moisture seal until installation of flashing materials.

.4 Installation of Composite Cover Board and Factory Laminated Base Sheet:

.1 Adhere base sheet board using adhesive applied in continuous strips spaced as required and based on manufacturer's instructions and the CSA A123.21 Wind Uplift Roof System Analysis Report.

.2 Heat seal side laps of the cover board with an industrial hot air welder as recommended by manufacturer.

.3 Line up end laps of the cover boards (not staggered) and apply primer as per manufacturer's recommendations and allow to "flash off" in preparation for the application of the self-adhesive cover strip membrane.

.4 Self-adhesive cover strip membrane shall be applied over each primed end lap of the cover board, rolled into place and a hot air welder is required to heat seal he side and end laps.

.5 Avoid the formation of wrinkles, swellings or fishmouths.

.5 Perimeter Fire Seal Application

.1 Apply perimeter fire seal to roof perimeter and curb substrates prior to applying base sheet materials. Apply fire seal to vertical joints in parapet or curb sheathing, and at vertical corners.

.2 Extend fire seal minimum 50 mm up parapet faces and extend fire seal minimum 75 mm onto adjacent substrates. Ensure air bubbles and fish mouths are removed.

.3 Install perimeter fire seal to act as temporary moisture seal until installation of flashing materials.

.6 Reinforced gusset installation:

.1 Install gussets at every angle, and on inside and outside corners.

.2 Install self adhesive gussets before installing self adhesive base sheet flashing membranes.

.7 Base sheet flashing installation:

.1 Apply base sheet flashing when primer coat is dry and in accordance with manufacturer's written instructions.

.2 Position pre-cut membrane pieces; peel back 100 mm to 150 mm of silicone release paper to hold the membrane in place at the top of the parapet, then gradually peel back remaining silicone release paper, pressing down on the membrane with aluminium applicator to provide good adhesion and to provide smooth transition between up-stand and

field surface; smooth entire membrane surface with a roller for full adhesion.

.3 Cut off corners at end laps being covered by next roll.

.4 Install a reinforcing gusset in all inside and outside corners.

.5 Seal overlaps at the end of each workday.

.8 Cap sheet application – torched:

.1 Once base sheet is applied and no defects are apparent, proceed with cap sheet installation.

.2 Unroll cap sheet at drain. Carefully align first side lap (parallel to roof edge).

.3 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.

.4 Avoid overheating. Take care to avoid excessive bitumen bleed-out at joints during installation.

.5 Use torches with auto shut offs only.

.6 Unless overlap widths differ between cap and base sheets, make sure joints between the two layers are staggered by at least 300 mm.

.7 Overlap cap sheet side laps by 75 mm and end laps by 150 mm. Cut off corners at end laps to be covered by next roll. Overlap surfaces must be granule-free or degranulated.

.8 Complete welds between two membranes. Leave no zone unwelded. In cold weather, adjust welding time to obtain homogenous seam.

.9 Once cap sheet is installed, carefully check overlapped joints. Leave bleed-out at joints ungranulated until inspected and accepted by the roofing inspector. Apply coloured granules to bleed-out area by priming with self-adhesive primer, and while still tacky shake granules onto surface and press into place.

.9 Cap Sheet Flashings Application:

.1 Install cap sheet in one (1) metre widths. Overlap side laps by 75 mm. Stagger base and cap sheet overlaps on roof by at least 100 mm to avoid excessive layering. Make overlaps 150 mm wide.

.2 Draw parallel chalk line 150 mm from up stand or parapet bases.

.3 Sink surface granules into bed of hot bitumen with torch and round-nosed trowel from chalk line on roof to up stand or parapet base as well as over granulated vertical parts to be overlapped.

.4 Torch weld cap sheet directly onto base sheet from top to bottom to soften both membranes and obtain homogenous seal.

.5 During installation, avoid overheating membrane and excessive bitumen bleed-out at joints.

.10 Roof penetrations:

.1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.8 WALKWAYS

.1 Install walkway membrane in accordance with manufacturer's instructions and as indicated on roof plan.

3.9 FIELD QUALITY CONTROL

.1 Inspection of roofing application will be carried out by Williams Engineering in cooperation with Departmental Representative.

.2 Manufacturers' Field Services:

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's field services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review Work at stages listed:
  - .1 After delivery and storage of products, and when preparatory Work 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.
- .4 Obtain reports within three days of review and submit.

3.10 CLEANING

.1 Remove bituminous markings from finished surfaces.

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

.3 Repair or replace defaced or disfigured finishes caused by work of this section.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction Waste Management and Disposal.

- .1 Place materials defined as hazardous or toxic in designated containers.
- .2 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
- .3 Ensure emptied containers are sealed and stored safely.
- .4 Divert unused aggregate materials from landfill to local quarry or facility for reuse as reviewed by Departmental Representative.
- .5 Unused coating material must be disposed of at official hazardous material collections site as reviewed by Departmental Representative.
- .6 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.7 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

.8 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.

.9 Dispose of unused asphalt material at official hazardous material collections site approved by Departmental Representative.

.10 Divert unused gypsum materials from landfill to recycling facility as reviewed by Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Alberta Roofing Contractor's Association (ARCA)

.1 Manual on Good Roofing Practice and Accepted Roofing Systems.

.2 The Aluminum Association Inc. (AA)

.1 Specifications for Aluminum Sheet Metal Work in Building Construction.

.2 DAF45-03, Designation System for Aluminum Finishes.

.3 American Society for Testing and Materials International (ASTM)

.1 ASTM A240/A240M-14, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.2 ASTM A606/A606M-09a, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.

.3 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.5 ASTM B32-08, Standard Specification for Solder Metal.

.6 ASTM B370-12, Standard Specification for Copper Sheet and Strip for Building Construction.

.7 ASTM D523-14, Standard Test Method for Specular Gloss.

.8 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.9 ASTM D4586-07(2012) e1, Standard Specification for Asphalt Roof Cement, Asbestos-Free.

.4 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual

.5 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

.6 Canadian Standards Association (CSA International)

.1 CSA A123.3-05 (R2010), Asphalt Saturated Organic Roofing Felt.

.2 AAMA/WDMA/CSA 101/I.S.2/A440-2009, Standard/Specification for Windows, Doors, and Skylights, Includes Update No. 1 (2013).

.3 CSA B111-74(R2003), Wire Nails, Spikes and Staples.

.7 Green Seal Environmental Standards

.1 Standard GS-03-97, Anti-Corrosive Paints.

.2 Standard GS-11-10, Paints and Coatings.

.3 Standard GS-36-00, Commercial Adhesives.

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

.1 Material Safety Data Sheets (MSDS).

.9 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule #1113-04, Architectural Coatings.

.2 SCAQMD Rule #1168-05, Adhesives and Sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate work of this Section with interfacing and adjoining Work for proper sequencing of each installation and to provide positive weather resistance, durability of the work, and protection of materials and finishes.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY CONTROL

.1 Installer: Engage an experienced installer having a minimum of three years experience who has completed projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

.2 Construct and install roof metal flashings in accordance with ARCA Manual details and in accordance with the ARCA Manual. If requirements conflict, this specification takes precedence over the manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Stack pre-formed and pre-finished material in manner to prevent twisting bending and rubbing.

.2 Provide protection for galvanized surfaces.

.3 Prevent contact of dissimilar metals during storage and protect from acids, flux, and other corrosive materials and elements

.4 Protect prefinished surfaces from scratches and from rust staining.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 WARRANTY

.1 The same warranty provisions apply to flashings associated with roofing as to the roofing.

.2 Provide Warranty for sheet metal flashing and trim to include in maintenance manuals as specified in Section 01 78 00 – Operations and Maintenance Data Manuals.

Part 2 Products

2.1 METAL FLASHINGS

.1 Zinc coated galvanized steel sheet (pre-finished): Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

- .1 Class: F1S-Finished one side
- .2 Thickness: minimum 0.45 mm base metal thickness.
- .3 Factory Finish: silicone modified polyester
- .4 Colour (intent is to match as close to existing as possible):
  - .1 Compound Building – to match new cap flashing on the recently replaced sections of this building's roofs from manufacturers full colour range, provide sample to Consultant for review.
  - .2 Garage Building – to match existing fascia colour from manufacturers full colour range, provide sample to Consultant for review.

2.2 EAVES TROUGHS AND DOWNSPOUTS

.1 Form downspouts from 0.7 mm thick galvanized prefinished steel sheet metal. Sizes and profiles as indicated.

.2 Form eaves troughs from 0.7 mm thick galvanized prefinished steel. Sizes and profiles as indicated.

.3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

.4 Colour to match existing building fascia from manufacturers full colour range, provide sample to Consultant for review.

2.3 SCUPPERS

.1 Form scuppers from 0.70 mm thick galvanized prefinished steel.

.2 Sizes and profiles as indicated.

.3 Provide necessary fastenings.

2.4 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Roofing Cement: to ASTM D4586, asphalt based, asbestos free.

.3 Sealants: as indicated in Section 07 92 00 - Sealants.

- .1 Mastic Sealant: CAN/CGSB 37.29 polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
- .2 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00.

.4 Fasteners: of same material as sheet metal, to CSA B111, as recommended by sheet metal manufacturer; non-corrosive. Finish of exposed parts to match material being fastened.

.5 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.6 Solder: to ASTM B32, alloy composition Sn.

.1 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered

.7 Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet metal.

.8 Metal Accessories: Provide non-corrosive sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work. Accessories shall match or be compatible with material being installed; size and thickness as required.

.9 Touch-up paint: as recommended by prefinished material manufacturer.

2.5 FABRICATION

.1 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.

.2 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.3 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

.4 Make flashings of prefinished metal for all cap flashings, for all flashings adjacent to roofing at roof edges and area dividers and where exposed to view from ground. Make flashings for other locations, of plain galvanized metal as follows:

.1 Use 0.45 mm metal core thickness except where otherwise indicated.
.2 Use 0.62 mm metal core thickness wherever a flat length exceeding 305 mm wide occurs.
.3 Use 0.80 mm metal core thickness for concealed fastening strips.

.5 All straight run joints shall be S-Lock in roof flashings.

.6 Make joints to allow for thermal movement, space S-Lock joints at 1500 mm maximum centers.

.7 Make flashings for building into masonry and concrete so that joints can be lapped 100 mm or more.

.8 Strengthen free edges of metal flashings by folding to form a 13 mm hem.

.9 Make flashings to curbs, walls and parapets a minimum of 200 mm high, where possible.

.10 Make joints for corners and intersections with standing seams except where exposed of pre-finished metal when seams shall be flat locked.

.11 All bends machine made; form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.12 Back paint metal flashings in contact with dissimilar metals or materials with bituminous paint that would result in electrolytic action or corrosion.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSPECTION

.1 Check mounting and counterflashing of mechanical items and report any defect to the Departmental Representative.

.2 Verify that solid wood blocking or sheathing provided to back-up all flashings and that all nails, screws set and wood provides a smooth flat plane.

.3 Verify that all reglets, provided under other Sections or built-in by other trades, properly and securely located, true and level in line.

3.3 INSTALLATION: METAL FLASHING

.1 Apply metal roof flashing to ARCA recommended requirements as a minimum.

.2 Do not install metal flashings over flexible roof flashing until the flexible roof flashing has been inspected and approved by the Roofing Inspector. This includes curbs for roof mounted items.

.3 Fasten metal base flashing to walls or upstands along top of flashing. Do not secure to cant strip. Form lapped corner joints. Extend rolled edge of base flashing approximately 25 mm on to roof from toe of cant, and rest on top of roof surface.

.4 Do not use exposed fastening unless indicated, or concealed fastening is not possible. Locations and methods shall be approved by Departmental Representative.

.5 Provide underlay under sheet metal.

.1 Secure in place and lap joints 100 mm.

.6 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.

.1 Flash joints using S-lock forming tight fit over hook strips, as detailed.

.7 Lock end joints and caulk with sealant.

.8 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

.9 Insert metal flashing under cap flashing to form weather tight junction.

.10 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

.11 Caulk flashing at cap flashing with sealant.

.12 Install pans, where shown around items projecting through roof membrane.

.13 All exposed and pre-finished flashings to provide a smooth flat surface free of indentations, bumps, oil-canning, or twists, all edges, bends hard, sharp and true to line.

3.4 INSTALLATION: EAVES TROUGHS AND DOWNSPOUTS

.1 Install eaves troughs and secure to building at 750 mm on centre with eaves trough spikes through spacer ferrules.

.1 Slope eaves troughs to downpipes as indicated.

.2 Seal joints watertight.

.2 Install downpipes and provide goosenecks back to wall.

.1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two straps per downpipe.

.2 Connect downpipes to drainage system and seal joint with plastic cement.

.3 Install splash pans as indicated.

3.5 INSTALLATION: SCUPPERS

.1 Install scuppers as indicated.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

.3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM A506-12, Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled.

.2 ASTM B370-12, Standard Specification for Copper Sheet and Strip for Building Construction.

.3 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM D2369-10e1, Standard Test Method for Volatile Content of Coatings.

.5 ASTM D2832-92(R2011), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.

.6 ASTM D5116-10, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

.7 ASTM F1667-11ae1, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.2 Environmental Choice Program (ECP).

.1 CCD-045-95, Sealants and Caulking Compounds.

.2 CCD-047-05, Architectural Surface Coatings.

.3 CCD-048-06, Surface Coatings - Recycled Water-borne.

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and technical data sheet.

.2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada. Indicate VOC's for caulking materials during application and curing.

.2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:

.1 Indicate size and description of components, materials, attachment devices, description of frame and finish, and construction details.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for hardware complete with pertinent details, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 - Closeout Submittals.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

1.5 JOB CONDITIONS

.1 Verify related work of other trades is complete prior to installing roof hatch and coordinate installation with roof membrane and roof insulation.

.2 Verify that an air seal has been properly installed prior to installation of roof hatch.

Part 2 Products

2.1 PERFORMANCE/DESIGN CRITERIA

.1 Roof hatches to withstand external load of 1.9 kPa and internal load of 0.95 kPa and temperature range of 80 degrees C without damage to unit or permanent deformation to seals.

2.2 ROOF HATCH

.1 Provide roof hatches with insulated double wall lids and insulated double wall curb frame with integral deck mounting flange and lid frame counter flashing with welded sealed corner joints, continuous weather tight perimeter gasketing and hot dip galvanized hardware, and as follows:

.1 Size: as indicated on drawings.

.2 Curb and Lid Material: Galvanized steel sheet, nominal 2.0 mm minimum thickness, insulated sandwiched construction.

.3 Insulation: Glass fibre or Polyisocyanurate insulation board, minimum 50 mm thickness.

.4 Exterior Curb Liner: Curb as detailed on Drawings or Manufacturer's standard metal liner of same material and finish as metal curb.

.5 Hardware: Galvanized steel, counterbalanced spring latch with turn handles, butt or pintle type hinge system as standard for manufacturer, and padlock hasps inside and outside.

.6 Latching: Single point, using manufacturer’s standard latching mechanism.

2.3 ACCESSORIES

.1 Screws: galvanized steel for curb to structure and for hatch lip frame to outer attachment.

.2 Securing latch: hold open operating arm with vinyl grip handle to permit one-handed release.

.3 Resilient gasket/seal to inner face of lid in contact with hatch lid support frame.

.4 Isolation coating: alkali resistant bituminous paint or epoxy solution.

.5 Ladder Safety Post: Manufacturer's standard nominal 40 mm diameter galvanized steel tube ladder safety post; with post locking in place on full

extension to 1070 mm above roof surface and release mechanism to return post to closed position, finished with manufacturer's standard baked enamel finish.

.6 Safety Railing System: Manufacturer's standard safety rail system consisting of nominal 40 mm diameter rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation. Installed so that top of railing is 1070 mm above roof surface, finished with manufacturer's standard baked enamel finish, and as follows:

.1 Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.

.2 Fabricate joints exposed to weather in a watertight manner.

.3 Close exposed ends of handrail and railing members with prefabricated end fittings.

2.4 FABRICATION

.1 Fabricate components free of twists, bends, or visual distortion and insulated. Weld corners and joints.

.2 Assemble roof hatch components as indicated.

.3 Ensure continuity of weather-tight seal.

.4 Design flashings and extrusions to collect and lead off accumulated condensation.

.5 Zinc plate hardware and attachments and shop prime ready for field painting.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

.1 Erect components plumb, level and in proper alignment.

.2 Ensure continuity of building envelope air barrier and vapour retarder systems.

.3 Adjust and seal assembly with provision for expansion and contraction of components.

.4 Secure prefabricated curb assembly or brake formed metal curb to structure.

.5 Coat aluminum and copper in contact with dissimilar materials, with isolation coating.

.6 Secure and seal frame to curb.

.7 Curb drip edge to be a minimum of 200 mm above the finished level of the new primary roof membrane for the termination of the new membrane stripping plies.

END OF SECTION

Part 1 General

1.1 INTENT

.1 This Section includes through penetration firestopping and smokeseal systems for penetrations through the following fire resistance rated assemblies, including both empty openings and openings containing penetrating items:

.1 Floors.

.2 Wall and partitions.

.3 Construction enclosing compartmentalized areas.

.2 This Section includes fire resistive joint systems for the following:

.1 Floor-to-floor joints.

.2 Floor-to-wall joints.

.3 Head-of-wall joints.

.4 Wall-to-wall joints.

.3 This specification section provides requirements for Rated Systems or systems requiring Engineered Judgements:

.1 Use of materials that have not been tested in a system or that are not capable of obtaining an engineered judgement will not be acceptable for use on this Project.

.2 Materials having only a ULC label will not be acceptable for use on this Project, unless supporting documentation is provided indicating its use in a listed assembly.

1.2 RELATED SECTIONS

.1 Division 23 Mechanical

.2 Division 26 Electrical

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM E119-12a, Standard Test Methods for Fire Tests of Building Construction and Materials.

.2 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM E814-13a, Standard Test Method for Fire Tests of Penetration Firestop Systems.

.4 ASTM A1008/A1008M-13, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

.5 ASTM E1966-07(2011), Standard Test Method for Fire-Resistive Joint Systems.

.6 ASTM E2174-10ae1, Standard Practice for On-Site Inspection of Installed Fire Stops.

.7 ASTM E2307-10, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.

.8 ASTM E2393-10a, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

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

.1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Agency (NFPA)

.1 NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 2006 Edition.

.4 Underwriter's Laboratories of Canada (ULC)

.1 ULC Guide No. 40 U19-1998, Firestop Systems.

.2 CAN/ULC S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.3 CAN/ULC S102-10, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.

.4 CAN4 S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.5 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.

.6 CAN/ULC S702-09-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1(January 2012).

.7 ULC S702.2-10, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

.8 List of Equipment and Materials.

.5 Underwriters Laboratories Inc. (UL)

.1 ANSI/UL 1479, Standard for Fire Test of Through-Penetration Firestops.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 – Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.5 SUBMITTALS

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

.1 Not later than 30 working days following Award of Contract, submit a schedule listing surfaces or components to which firestopping and smokeseals is to be applied, and indicating the firestopping and smokeseals system and materials required and detailing installation.

.2 Where possible determine thickness to be applied from tests of assemblies identical to the assembly to be protected, conducted in accordance with ULC S-101, ASTM E119, ULI 1479, NFPA 251, and ASTM E814.

.3 Determine system from available engineering studies, or correspondence with the labelling agency indicating the effect of the differences on the fire separation of the assembly. Confirm acceptance of system by authorities having jurisdiction in writing.

.4 Where the assembly includes conditions that do not correspond to those included in any previously tested assembly and for which no relevant engineering information is available use the same system and material as would be required for a tested assembly with similar conditions.

.2 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.

.3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in fire stopping installations and approved by manufacturer with 5 years documented experience.

.2 Use materials and methods of determining required thickness of application that have the full acceptance of authority having jurisdiction.

.3 Use materials tested to CAN/ULC-S115. Assemblies containing the materials shall be in accordance with assemblies tested and approved by agencies acceptable to authority having jurisdiction.

.4 Source Responsibility: Obtain through penetration firestop and joint systems, for each kind of penetration and construction condition indicated, from a single source of installation responsibility.

.5 Delegated Design Professional: Use a professional engineer, registered in the province of the Work and familiar with installations of similar scope and complexity to design firestopping and smokeseals.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

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

.3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.

.2 Storage and Protection:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.3 Use stock before its expiration date.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 PROJECT CONDITIONS

.1 Install firestopping and smokeseals materials only when the areas in which they are scheduled are closed-in and protected from dampness.

.2 Environmental Limitations: Install firestopping and smokeseals systems when ambient or substrate temperatures are within temperature and moisture limits permitted by firestopping and smokeseals system manufacturers or when substrates are not wet due to rain, frost, condensation, or other causes.

.3 Ventilate firestopping and smokeseals systems in accordance with manufacturer's written instructions by natural means or forced air circulation where natural means are not adequate.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 3M Canada Inc.

.2 A/D Fire Protection Systems Inc.

.3 EZ-Path Fire Rated Pathways

.4 Firestop Systems Inc.

.5 Hilti Canada Ltd.

.6 Johns Manville Fire Protection Systems

.7 Nuco Self Seal Firestopping Products.

.8 Passive Fire Protection Partners Firestop Systems Inc.

.9 Roxtec, Preformed Fire Stopping Systems

.10 Specified Technologies Inc.

.11 Tremco Ltd.

2.2 PERFORMANCE/DESIGN CRITERIA

.1 Delegated Design Requirements: Design firestopping and smokeseals required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as described in Section 01 35 00.

.2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the Building Code, Underwriters Laboratories Canada, and authorities having jurisdiction, and as follows:

.1 Provide through penetration firestop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of assembly penetrated:

.1 Fire resistance rated load bearing walls, including partitions, with fire protection rated openings.

.2 Fire resistance rated non-load bearing walls, including partitions, with fire protection rated openings.

.3 Fire resistance rated floor assemblies.

.2 F-Rated Systems: Provide through penetration firestop systems with F-ratings indicated, as determined by ULC S115 or ASTM E814, but not less than that equalling or exceeding fire resistance rating of constructions penetrated.

.3 T-Rated Systems: For the following conditions, provide through penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per by ULC S115 or ASTM E814, where systems protect penetrating items exposed to potential contact with adjacent materials:

.1 Penetrations located outside wall cavities.

.2 Penetrations located outside fire resistive shaft enclosures.

.3 Penetrations located in construction containing fire protection rated openings.

.4 Penetrating items larger than 100 mm diameter nominal pipe or 100 cm^2 in overall cross sectional area.

.4 Firestopping and Smokeseals Systems Exposed To View: Systems exposed to view, traffic, moisture, and physical damage; provide products that after curing do not deteriorate when exposed to these conditions both during and after construction, and as follows:

.1 Provide moisture resistant through penetration firestop systems for piping penetrations for plumbing and wet pipe sprinkler systems.

.2 Provide firestopping and smokeseals systems capable of supporting floor loads involved either by installing floor plates or by other means for floor penetrations with annular spaces

exceeding 100 mm in width and exposed to possible loading and traffic.

.3 Provide firestopping and smokeseals systems not requiring removal of insulation for penetrations involving insulated piping.

.4 Provide products with flame spread ratings of less than 25 and smoke developed ratings of less than 50 for firestopping and smokeseals and joint systems exposed to view.

.5 Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equalling or exceeding fire resistance rating of constructions in which joints are located.

2.3 FIRESTOPPING AND SMOKESEALS: GENERAL

.1 Compatibility: Provide firestopping and smokeseals systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestopping and smokeseals systems, under conditions of service and application, as demonstrated by firestopping and smokeseals system manufacturer based on testing and field experience, and as follows:

.1 Service penetration assemblies: certified by ULC in accordance with ULC S115 and listed in ULC Guide No. 40 U19.

.2 Service penetration firestopping and smokeseals components: certified by ULC in accordance with ULC S115 and listed in ULC Guide No. 40 U19.13, under the Label Service of ULC.

.3 Fire resistance rating of installed firestopping and smokeseals assembly not less than the fire resistance rating of surrounding floor and wall assembly.

.4 Firestopping and Smokeseals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.

.5 Firestopping and Smokeseals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations. Exemption to fire dampers.

.2 Accessories: Provide components for each firestopping and smokeseals systems that are needed to install fill materials. Use only components specified by firestopping and smokeseals system manufacturer and approved by the qualified testing and inspecting agency for firestopping and smokeseals systems indicated. Accessories include, but are not limited to, the following items:

.1 Permanent forming, damming and backing materials, including the following:

.1 Slag or rock wool fibre insulation.

.2 Sealants used in combination with other forming, damming or backing materials to prevent leakage of fill materials in liquid state.

.3 Fire-rated form board.

.4 Fillers for sealants.

.2 Temporary forming materials.

.3 Substrate primers.

.4 Collars.

.5 Steel sleeves.

.6 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.7 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.8 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m^2, minimum metal core thickness 0.912 mm.

.9 Steel Deck Moulded Flute Inserts: One piece moulded mineral fibre flute inserts, sized for steel deck profiles, for placement at top of fire rated wall assemblies:

.1 Acceptable material: Hilti CP777 Speed Plugs.

.10 Labels: Peel-and-stick labels printed with the following information:

.1 ATTENTION: FIRE RATED ASSEMBLY. DO NOT MODIFY

.2 Name of firestopping manufacturer

.3 Names of products used

.4 Hour Rating of Assembly

.5 Manufacturers standard detail number, or Engineered Judgement identifier; ULC or $_c$UL$_{us}$ Number

.6 Date of installation

.7 Name of installing SubContractor

.8 Contact telephone number for repair or replacement of firestopping materials.

2.4 FILL MATERIALS

.1 General:

.1 Provide firestopping and smokeseals systems containing the types of fill materials indicated in the Firestopping and Smokseals System Schedule below by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

.2 Firestopping and smoke seal systems shall be tested in accordance with ULC S115, and be comprised of asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases, and not to exceed opening sizes for which they are intended for the ratings as indicated on drawings.

.2 Cast-in-Place Firestopping and Smokeseals Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

.3 Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

.4 Firestopping and Smokeseals Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.

.5 Cable Penetration Devices: Premanufactured intumescent blocks, consisting of a system of inserts and adjustable cores; or premanufactured fire rated cable pathway systems, the following products are acceptable:

.1 EZ-Path Fire Rated Pathway, Specified Technologies Inc.

.2 CP 653 Speed Sleeve, Hilti

.3 Intumescent Blocks CFS-BL, Hilti

.4 Intumescent Blocks, Roxtec.

.6 Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.

.7 Intumescent Putties: Non-hardening dielectric, water resistant putties containing no solvents, inorganic fibres, or silicone compounds.

.8 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.

.9 Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.

.10 Mortars: Pre-packaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.

.11 Pillows/Bags: Reusable, heat expanding pillows/bags consisting of glass fibre cloth cases filled with a combination of mineral fibre, water insoluble expansion agents and fire retardant additives.

.12 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

.13 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:

.1 Grade for Horizontal Surfaces: Pourable (self levelling) formulation for openings in floors and other horizontal surfaces.

.2 Grade for Vertical Surfaces: non-sag formulation for openings in vertical and other surfaces.

2.5 ACCESSORIES

.1 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.2 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.3 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.4 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m^2, minimum metal core thickness 0.95 mm (20 ga.).

2.6 MIXING

.1 For those products requiring mixing before application, comply with firestopping and smokeseals system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection

of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

.1 Examine surfaces, components, materials to receive firestopping and smokeseals material; report any conditions which would detrimentally affect the application of the material or the proper firestopping and smokeseals of the system.

.2 Commence Work when conditions of surfaces and the working conditions are suitable.

.3 Where penetration sealants or caulking are required, ensure all service lines are in place, tested and approved.

.4 Verify all proper blocking, framing (using non-combustible materials) are properly installed and prepared to receive firestopping and smokeseals. Notify Departmental Representative in writing of any deficiencies affecting the proper performance of the firestopping and smokeseals, do not proceed until deficiencies are corrected.

3.3 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Prime surfaces as required.

.5 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.4 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Apply firestopping and smokeseals materials/systems to maintain the fire separations in the project as indicated on drawings.

.3 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.5 Tool or trowel exposed surfaces to neat finish.

.6 Remove excess compound promptly as work progresses and upon completion.

3.5 FIELD QUALITY CONTROL

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

.1 Cut tests may be made at random by the Departmental Representative. Frequency of cut tests shall be determined by the Departmental Representative, but will not be more than 1% of total length of firestopping and smokeseals.

.2 Make all necessary repairs and correct all deficiencies noted after completion of cut tests.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

.1 Design and provide through penetration firestopping and smokeseals as follows for:

.1 Systems with No Penetrating Items: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Silicone sealant.

.3 Intumescent putty.

.4 Intumescent foam blocks or boards.

.5 Intumescent spray foam.

.2 Systems for Metallic Pipes, Conduit, or Tubing: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Silicone sealant.

.3 Intumescent putty.

.4 Intumescent foam blocks or boards.

.5 Intumescent spray foam.

.3 Systems for Non-metallic Pipe, Conduit, or Tubing: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Silicone sealant.

.3 Intumescent putty.

.4 Intumescent wrap strips.

.5 Firestopping and Smokeseals device.

.6 Intumescent spray foam.

.4 Re-enterable and Cable Managed Systems for Electrical, and Data and Communications Cables:

.1 Prefabricated Firestop Sleeve CP653 (Hilti)

.2 Preformed Intumescent Blocks CFS-BL (Hilti)

.3 Preformed Intumescent Blocks (Roxtec)

.4 Prefabricated Cable Pathways (EZ-Path)

.5 Systems for Electrical, and Data and Communications Cables: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Silicone sealant.

.3 Intumescent putty.

.4 Silicone foam.

.5 Prefabricated Firestop Sleeve CP 653 (Hilti).

.6 Preformed Intumescent Blocks CFS-BL (Hilti)

.7 Preformed Intumescent Blocks (Roxtec).

.8 Prefabricated Cable Pathways (EZ-Path).

.9 Intumescent foam blocks or boards.

.10 Intumescent spray foam.

.6 Systems for Cable Trays: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Intumescent putty.

.3 Silicone foam.

.4 Pillows/bags.

.5 Intumescent foam blocks or boards.

.7 Systems for Insulated Pipes: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Intumescent putty.

.3 Silicone foam.

.4 Intumescent wrap strips.

.5 Intumescent foam blocks or boards.

.6 Intumescent spray foam.

.8 Systems for Miscellaneous Electrical Penetrations: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Intumescent putty.

.3 Intumescent foam blocks or boards.

.4 Intumescent spray foam.

.9 Systems for Miscellaneous Mechanical Penetrations: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Intumescent foam blocks or boards.

.3 Intumescent spray foam.

.10 Systems for Groupings of Penetrations: Select one or more of the following fill materials:

.1 Latex sealant.

.2 Intumescent wrap strips.

.3 Firestopping and Smokeseals device.

.4 Intumescent composite sheet.

.5 Intumescent foam blocks or boards.

.6 Intumescent spray foam.

.2 Design and provide joint firestopping and smokeseals as follows for:

.1 Floor-to-Floor, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: As indicated.

.2 Nominal Joint Width: As indicated.

.3 Movement Capabilities: Compression and extension.

.2 Floor-to-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: As indicated.

.2 Nominal Joint Width: As indicated.

.3 Movement Capabilities: To be confirmed, compression, extension, or horizontal shear.

.3 Head-of-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: As indicated.

.2 Nominal Joint Width: As indicated.

.3 Movement Capabilities: Compression and extension.

.4 Wall-to-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: As indicated.

.2 Nominal Joint Width: As indicated.

.3 Movement Capabilities: Compression and extension.

.3 Design and provide perimeter fire containment firestopping and smokeseals as follows for:

.1 Perimeter Fire Containment System: Provide materials to meet the following criteria:

.1 Integrity Rating: As indicated.

.2 Insulation Rating: As Indicated.

.3 Linear Opening Width: As indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.

.2 ASTM C920-14, Standard Specification for Elastomeric Joint Sealants.

.3 ASTM D2240-05(2010), Standard Test Methods for Rubber Property, Durometer Hardness.

.2 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

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

.1 Material Safety Data Sheets (MSDS).

.4 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.5 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.2 SUBMITTALS

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

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Caulking compound

.2 Primers

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.4 Manufacturers Sample Warranty

.2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for sealants. Indicate VOC content.

.3 Submit manufacturer’s installation instructions for each product used.

.4 When required by Departmental Representative, submit test certificates from an approved Canadian materials testing laboratory indicating that sealants meet the requirements of the CGSB standards specified, and that the tests have been conducted in accordance with ASTM D2240.

.2 Submit samples in accordance with Section 01 33 00 – Submittals Procedures.

.1 Provide colour samples of the actual sealants for approval; painted or printed colour charts are not acceptable.

1.3 QUALITY ASSURANCE

.1 Caulking shall be performed by a caulking contractor with 3 or more years successful experience in Work of similar size and complexity.

.2 Before performing Work of this Section, submit the names of proposed materials. If specified using CGSB Standards, indicate Qualification Number.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver containers labelled and sealed, complete with written application and maintenance instructions.

.3 Store materials in a dry heated enclosure in accordance with manufacturer's instructions.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

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

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.5 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.6 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.

.7 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.

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

1.6 PROJECT CONDITIONS

.1 Environmental Limitations:

.1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.

.2 When joint substrates are wet.

.2 Joint-Width Conditions:

.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

.2 Substrate must be clean, dry, and frost free.

1.7 WARRANTY

.1 Contractor hereby warrants that caulking work will not leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces in accordance with General Conditions, but for three (3) years.

.2 Provide Warranty for sealants to include in maintenance manuals as specified in Section 01 78 00 – Operations and Maintenance Data Manuals.

Part 2 Products

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

.3 Unless otherwise specified, VOC content limits of sealants shall be in accordance with SCAQMD Rule 1168 and as follows:

- .1 Architectural Materials:
  - .1 Sealants: VOC content limit 250 g/L.
  - .2 Sealant Primers for Non-Porous Surfaces: VOC content limit 250 g/L.
  - .3 Sealant Primers for Porous Surfaces: VOC content limit 775 g/L.
- .2 Roofing:
  - .1 Non-Membrane Related Sealants: VOC content limit 300 g/L.
  - .2 Single Ply Roofing Sealants: VOC content limit 450 g/L.
  - .3 SBS Membrane Sealant Primer: VOC content limit 500 g/L.
- .3 All Other Applications:
  - .1 Sealants: VOC content limit 420 g/L.
  - .2 Sealant Primers: VOC content limit 750 g/L.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Type S-1: Acrylic Latex One Part.

- .1 To CAN/CGSB-19.17.

.2 Type S-3: Silicone Sealant; general construction and air-seal sealant.

- .1 To CAN/CGSB-19.13 and ASTM C920: type S; grade NS; class 25; use NT, M, G, A, O.

.3 Type S-4: Silicone Sealant; structural glazing.

- .1 To CAN/CGSB-19.13 and ASTM C920: type S; grade NS; class 25; use NT, A, G, O.

.4 Type S-5: Acoustical Sealant; interior, non-hardening.

- .1 To CAN/CGSB-19.21.

.5 Type S-6: Multi-component polyurethane sealant; chemical curing, exterior wall sealant.

.1 To CAN/CGSB-19.24 and ASTM C920: type M; grade NS; class 50; use T, NT, M, A, O.

.6 Type S-7: One-component polyurethane sealant; non-sag, for general constructions.

.1 To CAN/CGSB-19.13 and ASTM C920: type S; grade NS; class 25; use NT, M, A, O.

.7 Type S-8: Horizontal joint sealant; two component, self-levelling.

.1 To CAN/CGSB-19.24 and ASTM C920: type M; grade P; class 25; use T, M, O.

.8 Type S-9: One part moisture curing, low modulus polyurethane sealant for sealing joints in level and slightly slope surfaces conforming to ASTM C920, type S, grade P, class 50, use T, M, A,O and CAN/CGSB 19.13, MC-1-25-B-N.

.9 Type S-10: Control joint sealant: two-component, epoxy-urethane, self-levelling, load bearing saw cut or preformed control joints.

.10 Type S-11: One-component polyurethane sealant; medium-modulus, low-VOC, UV stable.

.1 To CAN/CGSB-19.13 and ASTM C920: type S; grade NS; class 50; use NT, T, M, A, O, I.

2.3 ACCESSORIES

.1 Preformed Compressible and Non-Compressible back-up materials that are non-staining, compatible with joint substrate, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.

.1 Rod Type Sealant Backings:

.1 ASTM C1330, Type C (closed cell material with a surface skin), Type O (open cell material) or Type B (bi-cellular material with a surface skin).

.2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.

.3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

.4 Non-adhering to sealant, to maintain two sided adhesion across joint.

.2 High Density Foam.

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^3 density, or neoprene foam backer, size as recommended by manufacturer.

.3 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which will not bond to sealant.

.2 Preformed Sealants

.1 Preformed Silicone Sealant System: Manufacturer's standard system consisting of pre-cured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral curing silicone sealant for bonding extrusions to substrates:

.3 Primer: Non-staining type as recommended by sealant manufacturer.

.4 Joint Cleaner: Non-corrosive solvent type recommended by sealant manufacturer for applicable substrate materials.

2.4 COLOURS

.1 Colours: To match adjacent materials, as selected by Departmental Representative, from manufacturer’s standard colour range.

2.5 SEALANT SELECTION

.1 Where no specified type of sealant is shown or specified, choose one of the sealants specified in this Section appropriate for its location.

.2 Make sealant selections consistent with manufacturer’s recommendations.

.3 Use acrylic sealant Type S-1 only on the interior and only in situations where little or no movement can occur.

.4 Use silicone general construction sealant Type S-3 or Type S-6 and S-7 for all joints, interior and exterior, where no other specific sealant type specified.

.5 Use structural glazing silicone Type S-4 for sealing glass, interior and exterior.

.6 Use acoustical sealant Type S-5 and air seal sealant Type S-3 only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.

.7 Use multi-component sealant type S-6, primed penetration element surfaces other than concrete, for mechanical and electrical service penetrations in concrete foundation walls.

.8 Use multi-component sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.

.9 Use control joint sealant S-10 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.

.10 Use sealant S-11 for sealing exterior holes and penetrations around pipes and other services passing through concrete foundations.

Part 3 Execution

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 INSPECTION

.1 Carefully inspect surfaces, materials to receive sealants and verify they are physically capable of retaining sealant bond.

.2 Verify that fillers and backing provided under other Sections properly installed.

3.3 SURFACE PREPARATION

.1 Prepare surfaces in accordance with manufacturer's instructions.

.2 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.3 Maintain workmanship of highest quality in accordance with best trade practice.

.4 Ensure that joint forming materials are compatible with sealant.

.5 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work. Wire brush loose materials and other foreign matter which might impair adhesion of sealant.

.6 Use air stream to blow out dirt and water from crevices.

.7 Ensure joint surfaces are dry and frost free

.8 Prime all porous material (e.g. wood, masonry, concrete, ceramic or paver tile, etc).

.9 Prime other joints when recommended by manufacturer. Use a brush that will reach all parts of the joints. Mask adjoining surfaces with tape prior to priming to prevent staining.

3.4 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.5 BACKUP MATERIAL

.1 Use backer rod as specified, to limit depth of sealant and to act as bond breaker at back of joint.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

.3 Where depth of joint does not permit the use of backer rod apply paper masking tape to back of joint to act as bond breaker.

.4 Ensure that no joints are formed which are bonded on adjacent sides where there is any possibility of movement.

3.6 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.7 APPLICATION

.1 Apply sealant in strict accordance with manufacturer's recommendations.

.2 For joints where movement is possible, apply backer rod to achieve a joint depth of one half the joint width but not less than 9 mm; for joints larger than 25 mm use a depth of 13 mm

.3 Use pressure gun fitted with suitable nozzle. Use sufficient pressure to fill voids and joints solid.

.4 Form surface of sealant smooth, free from ridges, wrinkles, sags, or air pockets and imbedded impurities. Neatly tool surface to a slight concave appearance.

.5 Tool sealants to achieve air tight joints. Use wet tools as required.

.6 Ensure bead is solid, filling entire space between sides and bedding material, exerting sufficient pressure to obtain maximum bond, by allowing sealant to bulge out in advance of nozzle.

.7 Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature range.

.8 Seal perimeters of hollow metal door frames on both sides.

.9 Seal control joints in gypsum board and stucco, and junctures between interior partitions with exterior walls.

.10 Seal window and door frames around the inside perimeter, so that an airtight seal is obtained, as indicated on drawings.

.11 Seal joints in floors and walls and around service and mechanical and electrical fixture penetrations.

.12 Seal at all locations where dissimilar material meet.

.13 Curing

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

3.8 CLEAN UP

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

.4 On porous surfaces allow sealant to cure overnight, and remove excess by light wire brushing.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 ASTM B221-08, Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.4 ASTM E283-04, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.5 ASTM E331-00 (2009), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.

.6 ASTM E1105-00 (2008), 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.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-12.12-M90, Plastic Safety Glazing.

.2 CGSB 41-GP-6M-83, Sheets, Thermosetting Polyester Plastics, Glass Fibre Reinforced.

.3 CAN/CGSB-63.14-M89, Plastic Skylights.

.3 Canadian Standards Association (CSA International).

.1 CSA B111-1974, Wire Nails, Spikes and Staples.

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and technical data sheet.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's:

.1 For sealant materials during application and curing.

.2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:

.1 Indicate size and description of components, materials, attachment devices, description of frame and finish, and construction details.

.3 Submit samples in accordance with Section 01 33 00 – Submittals:

.1 Submit sample of plastic glazing for verification by Departmental Representative.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for cleaning and maintenance of plastic domes for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

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

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

.3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.

1.6 WARRANTY

.1 Provide 2 year manufacturers warranty against defects in material and workmanship.

Part 2 Products

2.1 SKYLIGHT

.1 Plastic skylights: to CAN/CGSB-63.14, Type 2 - Double glazed, Class A - Aluminum frame and as follows:

2.2 FRAME FINISH

.1 Class A - Aluminum frame: Class 1, 6063-T5, anodized finish to match existing.

2.3 SKYLIGHT GLAZING

.1 Plastic: to CAN/CGSB-12.12, category I, 3 mm thick, acrylic, flame spread rating of 125-145 and smoke developed: 400-500.

.2 Dome shape: to match existing

.3 Outer layer: clear plastic; Inner layer: white translucent colour plastic with the following values:

.1 Visible Light Transmittance: 53%

.2 Total Solar Transmittance: 53%

.3 Shading Coefficient: 0.43

2.4 CURB FRAME

.1 Fabricate curb as detailed on drawings.

2.5 ACCESSORIES

.1 Fasteners: screws to manufacturers standard stainless steel.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

.1 Install skylights in accordance with CAN/CGSB-63.14 and supplement as follows:

.1 Erect components plumb, level and in proper alignment.

.2 Ensure continuity of envelope air barrier and vapour retarder systems.

.3 Secure fabricated curb to structure.

.4 Adjust and seal assembly with provision for expansion and contraction of components.

.5 Secure and seal frame to curb.

3.3 CLEANING

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

.2 Remove traces of primer, caulking; clean doors and frames.

.3 Clean aluminum, track and hardware with damp rag and approved non-abrasive cleaner in accordance with manufacturers instructions.

.4 Remove protective film from plastic surfaces.

.5 Clean interior and exterior plastic surfaces in accordance with manufacturers' instructions.

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 03 30 00 – Cast-In-Place Concrete

.2 Section 03 35 00 – Concrete Finishing

.3 Section 06 10 00 – Rough Carpentry

.4 Section 07 92 00 – Sealants

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)

.1 ANSI/CTI (Ceramic) A108/A118/A136.1-2013, Specification for the Installation of Ceramic Tile - A Collection of 20 ANSI/CTI A108 Series Standards on Ceramic Tile Installation: A108.1A-C, 108.4 -.13, A118.1-.10, ANSI A136.1.

.2 CTI (Ceramic) A118.3-2013, Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1-2013).

.3 CTI (Ceramic) A118.4-2012, Specifications for Latex Portland Cement Mortar (included in ANSI A108.1-2013).

.4 CTI (Ceramic) A118.5-1999, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1-2013).

.5 CTI (Ceramic) A118.6-2010, Specification for Ceramic Tile Grouts (included in ANSI A108.1-2013).

.6 CTI/ANSI A137.1-2012, Testing for Dynamic Coefficient of Friction

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.

.2 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.

.3 ASTM C979/C979M-10, Standard Specification for Pigments for Integrally Coloured Concrete.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-75.1-M88, Tile, Ceramic.

.4 Canadian Standards Association (CSA International)

.1 CSA-A3000-13, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014).

.5 International Organization for Standardization (ISO)

.1 ISO 13007:2014, Classifications for Adhesives and Grouts.

.6 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.7 Tile Council of North America (TCNA)

.1 2015 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.

.8 Terrazzo Tile and Marble Association of Canada (TTMAC)

.1 Tile Specification Guide 09 30 00, 2012-2014, Tile Installation Manual.

.2 Hard Surface Maintenance Guide.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Preconstruction Meeting: Arrange a preconstruction meeting in accordance with Section 01 31 19 – Project Meetings attended by Contractor, Consultant, tile installer, tile supplier, and mortar and grout representative to discuss the following:

.1 Substrate and backing surfaces flatness requirements.

.2 Installation techniques associated with specified materials.

.3 Compatibility between specified materials and between adjacent materials.

.4 Concerns arising from site conditions.

.5 Concerns of installers or suppliers arising from as-constructed conditions.

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals Procedures:

.1 Include manufacturer's information on:

.1 Ceramic tile, marked to show each type, size, and shape required.

.2 Chemical resistant mortar and grout (Epoxy and Furan).

.3 Cementitious backer unit.

.4 Dry-set cement mortar and grout.

.5 Reinforcing tape.

.6 Levelling compound.

.7 Latex cement mortar and grout.

.8 Commercial cement grout.

.9 Waterproofing/Crack isolation membrane.

.10 Fasteners.

.2 Submit shop drawings in accordance with Section 01 33 00 – Submittals Procedures:

.1 Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, thresholds, and setting details.

.2 Locate and detail movement joints.

.3 Indicate swim lines, pool markings and other special patterns.

.3 Submit samples in accordance with Section 01 33 00 – Submittals Procedures:

.1 Tile: Submit actual tile samples illustrating colour, texture, size and pattern for each type of tile specified.

.2 Grout: Submit manufacturer’s full range of colours available for each type of grout specified.

.3 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.

.4 Adhere tile samples to 11 mm thick plywood and grout joints to represent project installation.

1.5 QUALITY ASSURANCE

.1 Conform to requirements of Terrazzo, Tile and Marble Association of Canada (TTMAC), Tile Specification Guide 09 30 00, 2012-2014, Tile Installation Manual.

.2 Obtain each type of tile material required from single source. For colour consistency, ensure the supplier has capacity to provide products from the same production run, dye lot, calibre and batch number.

.3 Obtain setting and grouting materials from one manufacturer to ensure compatibility.

.4 Installer Qualifications: Specializing in tile work having minimum of 5 years successful documented experience with work comparable to that required for this project. Installer must be registered as a member in good standing with the Terrazzo, Tile and Marble Association of Canada.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in containers with labels legible and intact and grade-seals unbroken.

.2 Store materials so as to prevent damage or contamination.

.3 Store materials in a dry area, protected from freezing, staining and damage.

.4 Store cementitious materials on a dry surface.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.

1.8 SITE CONDITIONS

.1 Surfaces for tile installation must be clean, dimensionally stable, cured, level, plumb and free of contaminants such as oil, sealers and curing compounds.

.2 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation. Tile and setting material stored at same conditions 48 hours before and 7 days after application.

.3 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.

.4 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

Part 2 Products

2.1 MATERIALS

.1 Factory blend tile that exhibits colour variations within the ranges selected and package so tile units taken from one package show the same range in colours as those taken from other packages.

.2 Provide tile products manufactured in accordance with CAN/CGSB 75.1 or ANSI A108.1 as appropriate to the Basis-of-Design Materials.

2.2 WALL AND CEILING TILE

.1 Ceramic tile: to CAN/CGSB-75.1, to match existing

2.3 MORTAR, GROUT, AND ADHESIVE MANUFACTURERS

.1 Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following manufacturers:

.1 Custom Building Products Ltd.

.2 Flextile Ltd.

.3 Laticrete International Inc.

.4 MAPEI Inc.

2.4 MORTAR AND ADHESIVE MATERIALS

.1 Mortar to be of the following properties unless otherwise specified:

.1 Cement: Grey meeting requirements of CSA A3000.

.2 Sand: to ASTM C144, passing 16 mesh.

.3 Hydrated lime: to ASTM C207, Type N.

.4 Latex additive: formulated for use in cement mortar and thin set bond coat.

.5 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.

.6 Mortars and Adhesives:

.1 Maximum VOC limit 65 g/L to SCAQMD Rule 1168.

.2 Quick Setting Thin-Set Mortar: fast-setting, two-component dry set mortar consisting of latex additive and mortar. Meet or exceed the requirements of ASTM C627 for Extra Heavy installation and comply with ANSI A118.4 and ISO 13007 C2FS2P2.

.1 Acceptable Products:

.1 254 Platinum Rapid, Laticrete International Inc.

.2 58XT 2-Component Fast Set Latex Mortar Systems, Flextile Ltd.

.3 Granirapid System consisting of Granirapid powder and Granirapid latex additive, MAPEI Inc.

.4 RapidSetting Commerical Bonding Mortar mixed with CustomFlex Ultra-Strength Thin-Set Additive, Custom Building Products.

2.5 GROUT

.1 Colouring Pigments:

.1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.

.2 Colouring pigments to be added to grout by manufacturer.

.3 Job coloured grout are not acceptable.

.4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.

.2 Ready-to-Use Grout: Professional-grade, ready-to-use colour consistent quartz aggregate, for use with grout joints 1.5 to 12 mm.

.1 Colour: Colours to match materials, confirm colour with Consultant prior to ordering.

.2 Basis-of-Design:

.1 Custom Building Products, Fusion Pro Component Grout

.2 Flextile Ltd., ColourMax Plus or Flex-Quartz

.3 Laticrete International Inc., Plasma

.4 MAPEI Inc., Flexcolor CQ

.3 Epoxy Grout: Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material; comply with ANSI A118.3 and ISO 130007 Classification R2/RG/ Classification RD for industrial grade.

.1 Colour: Colours to match materials, confirm colour with Consultant prior to ordering.

.2 Acceptable Products:

.1 CEG-Lite, CEG-IG 100% Solid Commercial Epoxy Grout, Custom Building Products.

.2 FlexEpoxy 100 – 100% Solids 2-Component Epoxy Grout, Flextile Ltd.

.3 Kerapoxy CQ Chemical Resistant Grout, MAPEI Inc.

.4 Latapoxy SpectraLOCK Pro Premium, Laticrete International Inc.

2.6 MEMBRANES

.1 Waterproofing Membrane: trowel applied elastomeric compound.

.1 Basis-of-Design:

.1 Mapelastic 315, MAPEI Inc

.2 RedGard Waterproofing and Crack Prevention Membrane, Custom Building Products

.2 Accessories:

.1 Preformed fibreglass mesh coving, inside and outside corners, and drain fittings.

.2 Preformed expansion joint flashing.

2.7 ACCESSORIES

.1 Mould resistant board: to ASTM C1396/C1396M and as follows:

.1 Type: regular and fire resistant.

.2 Size: 1200 mm x maximum practical length.

.3 Thickness: as indicated on Drawings.

.4 Acceptable materials:

.1 M2Tech Moisture & Mould Resistant Gypsum Board, CertainTeed.

.2 Sheetrock Mold Tough, CGC Inc.

.3 ToughRock Mold-Guard, Georgia-Pacific Canada, Inc.

.2 Metal lath: to ASTM C847 galvanized finish, 10 mm rib at 2.17 kg/m^2.

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

.1 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1168.

2.8 PATCHING AND LEVELLING COMPOUND

.1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

.2 Have not less than the following physical properties:

.1 Compressive strength - 25 MPa.

.2 Tensile strength - 7 MPa.

.3 Flexural strength - 7 MPa.

.4 Density - 1.9.

.3 Capable of being applied in layers up to 12 mm thick, being brought to feather edge, and being trowelled to smooth finish.

.4 Ready for use in 48 hours after application.

.5 Acceptable materials:

.1 59 Flex Flo with 4040 Concrete Primer, Flextile Ltd.

.2 LevelQuik ES with LevelQuik Latex Primer, Custom Building Products

.3 Novoplan Easy, MAPEI Inc

.4 NXT Level, Laticrete International Inc.

2.9 CLEANING COMPOUNDS

.1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

.2 Materials containing acid or caustic material are not acceptable.

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 datasheets.

3.2 PREPARATION

.1 Protect surrounding work from damage or disfiguration arising from work of this Section.

.2 Surfaces: Thoroughly clean substrate surfaces receiving tile finishes to remove grease, oil or dust films, and other contaminants affecting bond of materials within bonding systems and as follows:

.1 Clean back of each tile before installation to remove surface contaminants and cutting residue, firing release dust and other debris detrimental to bond and final surface appearance.

.3 Surface Levelling: apply self levelling compound to make backing surfaces flat and true to tolerances in plane listed in performance requirements above and as required by TTMAC.

3.3 WORKMANSHIP

.1 Do tile work in accordance with TTMAC Tile Installation Manual except where specified otherwise.

.2 Apply tile or backing coats to clean and sound surfaces.

.3 Back Buttering: Obtain minimum 95% mortar coverage in accordance with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108 series of tile installation standards for the following applications:

.1 Tile in wet areas:

.1 Showers

.2 Tile having tiles with raised or textured backs.

.3 All porcelain tiles with more than 20% of the tile backs covered with "white firing release" shall be "back buttered" so that 100% of the back is covered with adhesive mortar rated for C627, Extra Heavy Duty rating.

.4 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.

.5 Maximum surface tolerance 1:800.

.6 Make joints between tile uniform, plumb, straight, true, even and flush with adjacent tile. Confirm joint width with Consultant. Ensure sheet layout not visible after installation. Align patterns.

.7 Lay out tiles so perimeter tiles are minimum 1/2 size.

.8 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

.9 Install divider strips at junction of tile flooring and dissimilar materials.

.10 Allow minimum 24 hours after installation of tiles, before grouting.

.11 Clean installed tile surfaces after installation and grouting cured.

3.4 WATERPROOFING MEMBRANE INSTALLATION

.1 Install waterproofing membrane in accordance with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate. Confirm compatibility with existing membrane

.2 Install tiling after liquid applied membranes are cured.

3.5 CEILING TILE

.1 Install in accordance with TTMAC detail to match existing.

3.6 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 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.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Provide labour, materials, tools and other equipment, services and supervision required to complete interior and exterior, including above roof, painting and decorating work.

.2 Surface preparation for this section will be limited to priming and back-priming, and specific pre-treatments noted in this section or as specified in the Master Painters Institute (MPI) Painting Specification Manual.

1.2 RELATED REQUIREMENTS

.1 Other sections of the specification requiring painting refer to this section. Coordinate requirements of referencing sections.

1.3 REFERENCE STANDARDS

.1 Environmental Choice Program (ECP):

.1 Paints and Surface Coatings, Low VOC Product Listings

.2 The Master Painters Institute (MPI):

.1 New Surfaces: Architectural Painting Specification Manual.

.2 Existing Surfaces: Interior Maintenance Repainting Manuals.

.3 The Society for Protective Coatings (SSPC):

.1 Coating Materials Guidelines

.2 Surface Preparation Guidelines

.3 Application, Inspection and Quality Control Guidelines

1.4 DEFINITIONS

.1 Gloss Levels: Standard coating terms defined by MPI Manual apply to products of this Section as follows:

.1 G2 – Velvet: Matte to low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 0 to 10 when measured at 60°.

.2 G3 – Eggshell: Low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 10 to 25 when measured at 60°.

.3 G4 – Satin: Low to medium sheen with a gloss range of minimum 35 when measured at 85° to meter and 20 to 35 when measured at 60°.

.4 G5 – Semi-Gloss: Medium sheen finish with a gloss range of 35 to 70 when measured at 60° to meter.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 33 00 – Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit list of all painting materials used for the Work to the Consultant for review prior to ordering materials for each paint system indicated, including block fillers and primers:

.1 Material List: An inclusive list of required coating materials indicating each material and cross reference specific coating, finish system, and application; identify each material by manufacturer's catalogue number and general classification.

.2 Base Information: Confirmation of manufacturer’s ability to supply paint in a variety of base tints, specific to the range of colours being used on this project; indicate colour of base tint used and amount of colourant added to establish Scheduled colours.

.3 Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

.2 Samples: Provide stepped samples, defining each separate coat, including block fillers and primers using representative colours required for the project; label each sample for location and application, and as follows:

.1 Samples for Verification: When requested by the Consultant, provide samples for each colour and material, with texture to simulate actual conditions, on representative samples of the actual substrate as follows:

.1 Painted Wood: 200 mm long or square samples for each colour and material on representative sample wood used for the Work.

.2 Stained or Natural Wood: 200 mm long or square samples of natural or stained wood finish on representative species of wood used for the Work.

.3 Painted Gypsum Board: 200 mm long or square samples for each colour and material.

.3 Informational Submittals: Provide the following submittals when requested by the Consultant:

.1 Certification: Submit certification reports for paint products indicating that they meet or exceed low VOC and coloured base requirements listed in this Section.

.2 Purchase Orders: Retain purchase orders, invoices and other documents for verification of compliance with specification and design requirements.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit copies of paint manufacturer’s written maintenance information for inclusion in the operations manual in accordance with Section 01 78 00 including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

1.7 QUALITY ASSURANCE

.1 Conform to the standards contained in the MPI Manual.

.2 Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service performance, and as follows:

.1 Have a minimum of five (5) years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work.

.2 When requested provide a list of the last three comparable jobs including, name and location, specifying authority, start and completion dates and cost amount of the painting work.

.3 Only qualified journeymen who have a Tradesman Qualification Certificate of Proficiency shall be engaged in painting and decorating work.

.4 Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Conform to MPI Manual and manufacturer's requirements.

.2 Perform no painting or decorating work when the ambient air and substrate temperatures, relative humidity and dew point and substrate moisture content is below or above requirements for both interior and exterior work.

.3 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

.4 Ensure adequate continuous ventilation and sufficient heating and lighting is in place.

.5 Paint, stain and wood preservative finishes and related materials (thinners, solvents, caulking, empty paint cans, cleaning rags, etc.) shall be regarded as hazardous products. Recycle and dispose of same subject to regulations of applicable authorities having jurisdiction.

.6 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground retain cleaning water and filter out and properly dispose of sediments.

.7 Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

Part 2 Products

.1 Subject to compliance with requirements, manufacturers that have attained the prerequisites for ecologically sustainable labelling mark on their products and may be incorporated into the Work include; but are not limited to, the following:

.1 Benjamin Moore and Co. Limited

.2 ICI Paints (Canada) Inc.

.3 Para Paints

.4 PPG Canada Inc.- Architectural Finishes

.5 SICO Inc.

.6 Sherwin-Williams LLC

2.2 MATERIALS

.1 Primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and other painting materials shall be in accordance with the MPI Manual "Approved Product" listing and shall be from a single manufacturer for each system used.

.2 Materials such as linseed oil, shellac, and other accessory materials shall be the highest quality product of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials.

.3 All materials and paints shall be lead and mercury free and shall have low VOC content where possible.

Part 3 Execution

3.1 PREPARATION OF SURFACES:

.1 Prepare surfaces in accordance with MPI Manual requirements. Refer to the Manual for specific surface preparation requirements for each substrate material.

3.2 APPLICATION

.1 Paint when substrates and environmental conditions (heating, ventilation, lighting and completion of other work) are acceptable for applications of products specified in this Section.

.2 Paint surfaces requiring paint or stain finish to Premium MPI Manual finish requirements with application methods in accordance with best trade practices for type and application of materials used.

.3 Continue paint finishes through behind wall mounted items.

.4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.

.5 Apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results.

3.3 INTERIOR SURFACES

.1 Paint interior surfaces in accordance with the MPI Manual painting systems listed in this section.

.2 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etcetera):

.1 INT 5.3B – Water based light industrial coating semi-gloss finish.

.3 Plaster and Gypsum Board (gypsum board, drywall, and other sheet gypsum materials):

.1 INT 9.2B – High performance architectural latex semi-gloss finish.

3.4 MAINTENANCE REPAINTING

.1 Paint existing interior previously finishes surfaces in accordance with the MPI Manual painting systems listed in this section.

3.5 SITE QUALITY CONTROL

.1 Painted surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent at time of field review when viewed from a distance of 1220 mm from the painted surface:

.1 Runs, sags, hiding or shadowing by inefficient application methods

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles

.2 Painted surfaces will be considered as deficient if any of the following defects are apparent at time of field review, regardless of viewing distance.

.1 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.2 Damage due to application on moist surfaces or caused by inadequate protection from the weather.

.3 Damage or contamination of paint due to windblown contaminants (dust, sand blast materials, salt spray, etcetera)

.3 Painted surfaces found as unacceptable shall be replaced or repaired at no cost to the Owner or Consultant:

.1 Small affected areas may be touched up

.2 Large affected areas or areas without sufficient dry film thickness of paint shall be repainted.

.3 Runs, sags or damaged paint shall be removed by scraper or by sanding before application of new paint coats.

3.6 PROTECTION

.1 Protect newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry.

.2 Curing periods shall exceed the manufacturer’s recommended minimum time requirements.

.3 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.7 RESTORATION

.1 Clean and re-install all hardware items that were removed before painting operations were undertaken, ensuring that tagged or labelled items are returned to the exact position from which they were removed.

.2 Clean, prime and re-paint all bolts, nuts and fasteners after torqueing or re-tightening following specified paint finish.

.3 Remove protective coverings and warning signs as soon as possible after operations cease.

.4 Protect freshly painted surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

3.8 CLEANUP

.1 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, etcetera), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Not used.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings:

.1 At Departmental Representative's discretion, convene pre-installation meeting 1 week prior to beginning any or all portion(s) of work under this contract, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building construction subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets 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 Province of Alberta, Canada.

.2 Drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.3 Drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.5 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 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representativefor approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One glass for each gauge glass.

.4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

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

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect materials and equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 LOCAL SUPPORT

.1 Equipment and material suppliers without demonstrable local sales and service support will not be accepted, at the sole discretion of the Departmental Representative.

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 installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative, at their discretion.

.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 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23 - Interior Painting.

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

.3 Restore to new condition, finishes which have been damaged.

3.3 HAZARDOUS MATERIAL

.1 Hazardous material may be present in this project; comply with any and all mitigation and abatement requirements identified in Division 01.

3.4 SYSTEM CLEANING

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

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.6 DEMONSTRATION

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

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

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

.4 Record these demonstrations on video tape or on acceptable digital media and provide copies to Departmental Representative for future reference.

3.7 CLOSEOUT ACTIVITIES

.1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.

.2 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

3.9 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 CSA International

.1 CSA-B64 Series-11, Backflow Preventers and Vacuum Breakers.

.2 CSA B79-08, Commercial and Residential Drains and Cleanouts.

.3 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP).

.1 IPMVP 2007 Version.

Part 2 Products

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to CSA B79.

.2 Type 1: general duty; cast iron body round, adjustable head, nickel bronze strainer, integral seepage pan, and clamping collar.

.3 Type 3: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel.

2.2 ROOF DRAINS

.1 Type 2: standard roof drain with cast iron body with cast iron dome, under-deck clamp to suit roof construction, flashing clamp ring with integral gravel stop.

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: nickel bronze round, gasket, vandal-proof screws.

.3 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.4 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.4 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application as indicated,.

2.5 WATER MAKE-UP ASSEMBLY

.1 Complete with backflow preventer, pressure gauge on inlet and outlet, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

2.6 STRAINERS

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

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

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

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 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.

3.3 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada, provincial codes, and local authority having jurisdiction.

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

3.4 CLEANOUTS

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

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

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 BACK FLOW PREVENTERS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.1 Drains.

.2 Water Make-up Assembly.

.2 Pipe discharge to terminate over nearest drain or service sink.

3.6 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.7 WATER MAKE-UP ASSEMBLY

.1 Install on valved bypass.

.2 Pipe discharge from relief valve to nearest floor drain.

3.8 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.9 TESTING AND ADJUSTING

.1 General:

.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements : General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:

.1 Prime traps.

.2 Check operations of flushing features.

.3 Check security, accessibility, removability of strainer.

.4 Clean out baskets.

.6 Backflow preventers:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.7 Roof drains:

.1 Check location at low points in roof.

.2 Check security, removability of dome.

.3 Adjust weirs to suit actual roof slopes, meet requirements of design.

.4 Clean out sumps.

.5 Verify provisions for movement of roof systems.

.8 Access doors:

.1 Verify size and location relative to items to be accessed.

.9 Cleanouts:

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

.10 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.11 Hydronic system water Make-up Assembly:

.1 Verify flow, pressure, and connection.

3.10 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Definitions:

.1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:

.1 Rigid supply and return ductwork;

.2 Flexible ductwork;

.3 Mixing plenum boxes;

.4 Return air plenums including ceiling plenums;

.5 Cooling and heating coils and compartments;

.6 Condensate drain pans;

.7 Fans, fan blades and fan housing;

.8 Filter housing and frames;

.9 Acoustically insulated duct linings;

.10 Diffusers, registers and terminal units;

.11 Dampers and controls;

.2 Reference Standards:

.1 National Air Duct Cleaners Association (NADCA)

.1 ACR Standard, 2006 edition: Assessment, Cleaning and Restoration of HVAC Systems.

.2 North American Insulation Manufacturers Association (NAIMA)

.1 NAIMA 2005, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.

.3 United States Environmental Protection Agency (US EPA)

.1 US EPA 1999, 40 CFR Parts 152 and 156.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Site Evaluation: conduct site visit no less than 2 weeks before start of work to establish specific co-ordinated survey and cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.

.1 Organize and lay out plan for survey and identify cleaning apparatus insertion points.

.2 Ensure plan identifies sequence and schedule of survey and cleaning operations for each individual HVAC system and for complete facility.

.1 Take account of elbows, bends, turning vanes, dampers, transitions, take-offs, reheat coils, and other internal features.

.3 Departmental Representative to review survey and cleaning plan 1 week minimum prior to start of work.

.1 Proceed with survey and cleaning work only after receiving written approval from Departmental Representative.

.2 Scheduling: submit schedule of work to Departmental Representative for their approval prior to commencing air duct cleaning.

.3 Project Co-ordination: assign Project Co-ordinator to oversee air duct cleaning processes.

.1 Provide Departmental Representative with contact information of Project Co-ordinator including: name, telephone number, cell phone number, and email address.

.4 Security: Departmental Representative will pay costs and provide security escort at times requested on Contractor's submitted work schedule.

.1 Cancellation of security escort requires 72 hours minimum written notice.

.2 Failure to cancel security escort requirements 72 hours minimum before scheduled event will result in Contractor paying for security costs.

.5 Damaged or broken equipment and components found during initial testing and inspection will be repaired or replaced by Departmental Representative.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit survey and cleaning plan developed during site evaluation.

.1 Ensure plan includes sequence of operation, identification of inspection and cleaning apparatus insertion points and schedule for work.

.3 Product Data:

.1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.

.2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements for antimicrobial agents or coatings.

.4 US EPA Registration: submit verification of EPA Registration of antimicrobial agent.

1.5 CLOSEOUT SUBMITTALS

.1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.

.2 Post Cleaning Inspection Report: submit 4 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:

.1 Name and address of facility;

.2 Name and address of HVAC cleaning contractor;

.3 Description of HVAC systems with drawings identifying systems cleaned;

.4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;

.5 Identification of points where samples were collected and type of analysis used for each collection;

.6 Identification of each sample collected;

.7 Comments complete with photographs of each sampling location and other observed system features;

.8 Identify systems tested, observations, actions taken and recommendations for future maintenance.

.3 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility.

1.6 EXTRA MATERIALS

.1 Extra Stock Materials:

.1 Supply 4 extra filters for each HVAC System cleaned.

.2 Ensure filters are correct match, size, type and configuration of new HVAC Systems.

1.7 QUALITY ASSURANCE

.1 Contractor: verification of membership in NADCA and / or verification of 5 years minimum experience in work similar to or exceeding work of this Section.

.2 Project Co-ordinator: Air System Cleaning Specialist (ASCS) certified by NADCA on full time basis and / or verification of 5 years minimum experience in work similar to or exceeding work of this Section.

Part 2 Products

2.1 ACCESS DOORS AND PANELS

.1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.

.1 Size access doors and panels in equipment to allow for inspection and cleaning.

.2 Ductwork Access Doors: construct access doors from 1.27 mm minimum galvanized sheet steel with gasketted seal.

.1 Ensure access door is 25 mm greater in every dimension than access opening.

.2 Access door size 200mm x 200mm minimum.

.3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.

.3 Access Doors and Panels Acoustic Lining:

.1 Install acoustic lining to match existing.

.2 Self-adhesive glass fibre tape capable of adhering to both acoustic lining and metal access door or panel materials.

.3 Water-based duct sealer for repairing cut acoustic lining.

2.2 ANTIMICROBIAL AGENT

.1 Use antimicrobial agents registered with US EPA-40 CFR.

2.3 SYSTEM FILTERS

.1 Supply and install new filters for each HVAC System cleaned.

2.4 AIR DUCT CLEANING EQUIPMENT

.1 Manually propelled full contact brushes:

.1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.

.1 Ensure brushes are sized to fit various duct sizes in HVAC system.

.2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.

.2 Brushes: manually propelled with integrally-mounted drive and non-metallic material bristles.

.1 Ensure drive has capacity to continue to push brush after bristles are distorted.

.2 Replace worn and ineffective brushes when required.

Part 3 Execution

3.1 PREPARATION

.1 Close down HVAC system.

.2 Locate and identify externally visible HVAC system features which may affect cleaning process including:

.1 Control devices;

.2 Fire and smoke control dampers;

.3 Balancing dampers: indicate and record positions for resetting;

.4 Air volume control boxes: indicate and record positions for resetting;

.5 Fire alarm devices;

.6 Monitoring devices and controls;

.7 Reheat coils.

.3 Cut openings in equipment panels and ductwork for access to system interior.

.1 Square or rectangular opening sizes: 200 mm minimum each side.

.2 Circular opening sizes: 200 mm minimum diameter.

.4 Installation of Access Doors and Panels: install access doors and panels for equipment where required to facilitate system inspection and cleaning.

.1 Install access doors and panels for inspection and cleaning of equipment as follows:

.1 Heating coils;

.2 Fan units;

.3 Dampers;

.4 Sensors;

.5 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.

.1 Access door installation is not permitted in flexible ductwork.

.1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.

.6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.

.1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.

.7 Remove and reinstall ceiling tiles to gain access to HVAC system as required.

.1 Replace ceiling tiles damaged or soiled by air duct cleaning procedures.

3.2 EXAMINATION / PRE-CLEANING INSPECTION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical as modified by this Section.

.2 Verification of Conditions:

.1 Make visual inspection of interior of HVAC system.

.2 Inspect ductwork at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.

.3 Evaluation and Assessment:

.1 Identify location and type of internal components.

.2 Identify extent of potential problems.

.3 If toxic or hazardous materials or deposits are suspected after initial inspection immediately stop work and inform Departmental Representative.

.1 Do not proceed further with inspection operations until written approval from Departmental Representative.

3.3 DUCT CLEANING

.1 Do duct cleaning in accordance with NADCA ACR Standard.

.2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zone which has already been cleaned.

.1 Isolate zone of duct using closed-cell polyurethane foam or air inflated zone bag before cleaning.

.3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.

.4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.

.5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.

.6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.

.7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.

.1 Pass brushes through sections as often as necessary to achieve required cleanliness.

.2 Change brush sizes as required to ensure positive contact with duct and component interiors.

.3 Clean corners and pockets where dirt and debris can accumulate.

.8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.

.9 Clean diffusers, registers, louvers, and other terminal units.

.10 Remove perforated supply diffusers from suspended tee-bar ceiling.

.1 Dismantle and clean perforated plates and supply diffuser duct collars.

.2 Re-assemble perforated plate diffusers and reconnect to HVAC system using supply diffuser duct collar after cleaning.

.11 Advise Departmental Representative 72 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.

.1 Departmental Representative will pay for costs of deactivation of fire alarm and smoke detector system.

3.4 ACOUSTICALLY LINED DUCTWORK CLEANING

.1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices.

.1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.

.2 Monitor cleaning process progress by onboard camera.

3.5 COMPONENTS AND EQUIPMENT CLEANING

.1 Brush and vacuum coils and air handling unit enclosures to achieve required cleanliness.

.2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Departmental Representative for cleaning.

.1 Pressure wash with water and cleaning solution until required cleanliness is achieved.

.2 Clean equipment and components in place only if there is no hazard to adjacent materials.

.3 Proceed to next section in cleaning sequence only after written approval from Departmental Representative.

.4 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Departmental Representative:

.1 Fan blades;

.2 Dampers;

.3 Turning vanes;

.4 Controls;

.5 Sensor bulbs;

.6 Fire alarms;

.7 Smoke detectors;

3.6 ANTI MICROBIAL APPLICATION

.1 Apply antimicrobial agents when fungal growth is suspected or where unacceptable levels of fungal contamination have been verified through visual inspection or testing.

.2 Apply antimicrobial agents after removal of surface deposits and debris.

.1 Verify air duct interiors are free from deposits and debris by visual inspection.

.2 Report findings to Departmental Representative.

.3 Proceed with application of antimicrobial agents after written approval from Departmental Representative.

.3 Apply antimicrobial agents in accordance with manufacturer's written instructions and US EPA 40 CFR registration and listing.

.4 Manual or Robotic spray antimicrobial agents directly onto interior surfaces of HVAC air duct system.

.1 Do not use fog mist for downstream surfaces.

3.7 FIELD QUALITY CONTROL/FINAL INSPECTIONS

.1 Post Cleaning Inspection: carry out final inspection visual inspection methods after final cleaning has been completed.

.1 Carry out survey as directed by Departmental Representative.

.2 Include in final survey areas inspected by Contractor and / or Departmental Representative prior to cleaning.

.3 Identify on HVAC system record drawings access points used for inspection and cleaning.

.4 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

3.8 SYSTEM STARTUP

.1 Install new system filters after cleaning operations are completed.

.2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.

.3 Restart each HVAC system.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Dispose of hazardous or toxic waste materials extracted from ductwork system to appropriate contaminated waste facility and provide proof.

.2 Dispose of existing HVAC filter materials to appropriate contaminated waste facility.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Use of mechanical systems during construction.

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 USE OF SYSTEMS

.1 Use of new and existing permanent heating and ventilating systems for supplying temporary heat and ventilation is permitted with permission of the owner and only under following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.4 There is no possibility of damage.

.5 Supply ventilation systems are protected by 60% filters, inspected daily, changed every 2 weeks or more frequently as required.

.6 Return systems have approved filters over openings, inlets, outlets.

.7 Systems will be:

.1 Operated as per manufacturer's recommendations and instructions.

.2 Operated by Contractor.

.3 Monitored continuously by Contractor.

.8 Warranties and guarantees are not relaxed.

.9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.

.10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.

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

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.

.3 National Fire Code of Canada (NFCC 2005)

1.3 QUALITY ASSURANCE

.1 Not used.

Part 2 Products

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers, Paints, and Coatings: in accordance with manufacturer's recommendations for surface conditions.

.2 Primer: maximum VOC limit 250 g/L to Standard GS-11.

.3 Paints: maximum VOC limit 150 g/L to Standard GS-11.

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

.1 Sealants: maximum VOC limit to GSES GS-36.

.3 Sealants: maximum VOC limit to GSES GS-36.

.4 Adhesives: maximum VOC limit to GSES GS-36.

.5 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 APPLICATION

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

3.3 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.4 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer and as indicated without interrupting operation of other system, equipment, and components.

3.5 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain.

.1 Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.6 AIR VENTS

.1 Install manual air vents to at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.7 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.8 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as required and as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use ball valves at branch take-offs for isolating purposes except where specified.

.7 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.9 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for fire stopping.

.2 Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.10 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.11 PREPARATION FOR FIRE STOPPING

.1 Install fire stopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.12 FLUSHING OUT OF PIPING SYSTEMS

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

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.13 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Departmental Representative, at their discretion.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.14 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval by Departmental Representative10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.15 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 REFERENCES

.1 National Energy Code of Canada for Buildings 2011 (NECB)

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

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

.1 Material Safety Data Sheets (MSDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

.2 Waste Management and Disposal:

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

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.2 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards and to NECB.

2.3 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208/3 V, unless otherwise indicated.

2.4 TEMPORARY MOTORS

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

2.5 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

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

.4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.6 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

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

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

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

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

.5 Unprotected fan inlets or outlets:

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

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A105/A105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Manufacturer, model number, line contents, pressure and temperature rating.

.2 Movement handled, axial, lateral, angular and the amounts of each.

.3 Nominal size and dimensions including details of construction and assembly.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

.1 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.1 GROOVED END EXPANSION JOINTS

.1 Packless, Gasketted, Slip, Expansion Joints:

- .1 2413 kPa maximum working pressure.
- .2 Steel pipe fitting consisting of telescoping body and slip-pipe sections.
- .3 PTFE modified polyphenylene sulfide coated slide section.
- .4 Suitable for axial end movement to 75 mm.

.2 Expansion joint consisting of series of grooved end pipe nipples joined in tandem with flexible couplings. Total joint movement dependent on number of couplings and nipples used.

2.2 FLEXIBLE CONNECTION

.1 Application: to suit motion.

.2 Minimum length in accordance with manufacturer's recommendations to suit offset.

.3 Inner hose: bronze or stainless steel corrugated.

.4 Braided stainless steel outer jacket.

.5 Diameter and type of end connection: as indicated.

.6 Operating conditions:

- .1 Working pressure: 1034 kPa.
- .2 Working temperature: 82.2 degrees C.
- .3 To match system requirements.

.7 Three flexible grooved couplings placed in close proximity to vibration source for vibration attenuation and stress relief.

2.3 ANCHORS AND GUIDES

.1 Anchors:

- .1 Provide as indicated and as required.

.2 Alignment guides:

- .1 By conduit manufacturer.
- .2 To accommodate specified thickness of insulation.
- .3 Vapour barriers, jackets to remain uninterrupted.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 APPLICATION

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

3.3 INSTALLATION

.1 Install expansion joints with cold setting, as indicated. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

3.4 PIPE CLEANING AND START-UP

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

3.5 PERFORMANCE VERIFICATION

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

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

.3 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 IPMVP 2007 Version.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.2 GS-36-11, Standard for Commercial Adhesives.

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 thermometers and pressure gauges 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 Province of Alberta, Canada.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Test and Evaluation Reports:

.1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Ranges: to suit installation.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4.

.1 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Gasketted pressure relief back with solid front.

.2 Bronze stop cock.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.

.1 If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

.1 Install in wells on piping. Include heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Water boilers.

.3 Install wells as indicated only for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of control valves.

.3 Outlet of boilers.

.4 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

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

3.5 NAMEPLATES

.1 Install engraved lamacoid nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, identifying medium.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International

.1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta.

.2 Submit data for valves specified in this Section.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size. Minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.2 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

.2 Include following:

.1 Lubricant gun for expansion joints.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: solder ends or grooved ends to ANSI/ASME B16.18.

.3 Lockshield Keys:

.1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

.4 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating disc, composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel.

.3 NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel.

.4 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.

.3 Operator: handwheel.

.5 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.6 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: 2760-kPa CWP

.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders, or solder ends to ANSI.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.7 Butterfly Valves:

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

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

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASTM International Inc.

.1 ASTM A49-01(2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.

.2 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.3 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.

.4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM B85/B85M-08, Standard Specification for Aluminum-Alloy Die Castings.

.7 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS SP-61-03, Pressure Testing of Steel Valves.

.2 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.3 MSS SP-82-1992, Valve Pressure Testing Methods.

.4 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

1.4 CLOSEOUT SUBMITTALS

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.2 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size, minimum 1.

.3 Stem packing: one for every 10 valves, each size, minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.3 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

.2 Include following:

.1 Lubricant gun for expansion joints.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Globe valves: MSS SP-85.

.2 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B209 Class B or ductile iron to ASTM A536 Grade 65-45-12.

.2 Connections: flanged ends with 2 mm raised face with serrated finish, or grooved ends to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 GLOBE VALVES

.1 NPS 2 1/2 - 10, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, regrindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: handwheel.

.8 Bypass: complete with union and NPS globe valve as Section 23 05 23.01 - Valves - Bronze.

2.3 BYPASSES FOR GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.3 Type of bypass valves:

.1 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

2.4 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms.

2.5 CHECK VALVES

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.

.1 Up to NPS 16: cast iron to ASTM A126 Class B or ductile iron ASTM A536 Grade 65-45-12.

.2 Ratings:

.1 NPS 2 1/2 - 12: 1.4 MPa CWP.

.2 NPS 14 - 16: 1.03 MPa CWP.

.3 NPS 18 and over: 1.03 MPa CWP.

.3 Disc: rotating for extended life.

.1 Up to NPS 6: bronze to ASTM B62 or stainless steel type 316.

.2 NPS 8 and over: bronze-faced cast iron.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

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

.6 Disc: A126 Class B, secured to stem, rotating for extended life.

.7 Seat: cast iron, integral with body.

.8 Hinge pin: exelloy; bushings: malleable iron.

.9 Identification tag: fastened to cover.

.10 Hinge: stainless steel.

.2 Swing check valves, NPS 2 1/2 - 8 Class 250:

.1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.

.2 Flanged ends: 2 mm raised face with serrated finish.

.3 Rating: 250 psi steam; 500 psi CWP.

.4 Disc: rotating for extended life.

.1 Up to NPS 3: bronze to ASTM B61.

.2 NPS 4 - 8: iron faced with ASTM B61 bronze.

.5 Seat rings: renewable bronze to ASTM B61, screwed into body.

.6 Hinge pin, bushings: renewable, bronze to ASTM B61.

.7 Hinge: galvanized malleable iron.

.8 Identification tag: fastened to cover.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

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

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Clean installed products in accordance to manufacturer's recommendation.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ASME B16, Fittings and Valves Package.

.2 ASME B16.5-2009, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.

.3 ANSI/ASME B16.10-2009, Face-to-Face and End-to-End Dimensions Valves.

.4 ANSI/ASME B16.25-2007, Buttwelding Ends.

.5 ANSI/ASME B16.34-2009, Valves Flanged, Threaded and Welding End. Includes Supplement (2010).

.2 American Petroleum Institute (API)

.1 API STD 598-2009, Valve Inspection and Testing.

.3 ASTM International

.1 ASTM A49-12, Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars.

.2 ASTM A182/A182M-11a, Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.

.3 ASTM A193/A193M-12, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.

.4 ASTM A194/A194M-2011, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.

.5 ASTM A216/A216M-08, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.

.6 ASTM B85/B85M-10, Standard Specification for Aluminum-Alloy Die Castings.

.4 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 IPMVP 2007 Version.

.5 Green Seal Environmental Standards (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.2 GS-36-11, Standard for Commercial Adhesives.

.6 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

.1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS SP-61-2009, Pressure Testing of Valves.

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 each valve 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 Province of Alberta, Canada.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Extra Stock Materials:

.3 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size, minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 To be of single manufacturer.

.2 Test valves individually.

.2 Requirements common to valves, unless specified otherwise:

.1 Pressure-temperature ratings: to ANSI B16.34.

.2 Inspections and tests: to API 598.

.3 Pressure testing: to MSS SP-61.

.4 Flanged valves:

.1 Face-to-face dimensions: to ANSI B16.10.

.2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.

.5 Butt-weld valves:

.1 End-to-end dimensions: to ANSI B16.10.

.2 End dimensions: to ANSI B16.25 bored for standard pipe schedule.

.6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.

.7 Markings: to MSS SP-25.

.8 Identification:

.1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.

.2 Body markings: manufacturer, size, primary service rating, material symbol.

.9 CRN registration number required for all products.

2.2 GLOBE VALVES

.1 NPS 2 1/2 - 12, rising stem, OS Y, flanged ends, Class 150:

.1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB.

.2 Body/bonnet joint: male-female face with corrugated metallic gasket.

.3 Bonnet studs: to ASTM A193/A193M Type B7.

.4 Bonnet nuts: to ASTM A194/A194M Type 2H.

.5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.

.6 Gland packing: containing corrosion inhibitor to prevent stem pitting.

.7 Yoke bushing: Ni-Resist, minimum melting point above 954 degrees C.

.8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.

.9 Disc: plug type with 15 degrees taper seat and bottom guide.

.10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.

.11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.12 Operator: see elsewhere in this Section.

2.3 VALVE OPERATORS

.1 Handwheel: on all valves.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms.

2.4 BYPASSES FOR GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.3 Type of bypass valves:

.1 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.

2.5 CHECK VALVES

.1 NPS 2 1/2 and over, flanged ends, Class150: swing check.

.1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.

.2 Cap studs: to ASTM A193/A193M Type B7.

.3 Cap nuts: to ASTM A194/A194M Type 2H.

.4 Body/cap joint: male-female face with corrugated metallic gasket.

.5 Disc: heat treated corrosion and heat resistant 13% chromium steel.

.6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.

.7 Hinge: ASTM A182/A182M.

.8 Hinge pin: ASTM A182/A182M.

.9 Hinge pin plugs: ASTM A182/A182M.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

3.3 COMMISSIONING

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

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by cast steel valve installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-07, Power Piping.

.2 ASTM International

.1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.3 GENERAL

.1 Fabricate hangers and supports in accordance with MSS SP58.

2.4 PIPE HANGERS

.1 Finishes:

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

.2 Upper attachment structural: suspension from lower flange of I-Beam:

- .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut carbon steel retaining clip.
  - .1 Rod: 9 mm UL listed.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed.

.3 Upper attachment to concrete:

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

.4 Shop and field-fabricated assemblies:

- .1 Trapeze hanger assemblies.
- .2 Steel brackets.

.5 Hanger rods: threaded rod material to MSS SP58:

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

.6 Pipe attachments: material to MSS SP58:

- .1 Attachments for steel piping: carbon steel black.
- .2 Attachments for copper piping: copper plated black steel.
- .3 Use insulation shields for hot pipework.
- .4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

- .1 Ensure "U" has hole in bottom for riveting to insulation shields.

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

.9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated.

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

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 VARIABLE SUPPORT SPRING HANGERS

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

.2 Variable spring hanger complete with factory calibrated travel stops.

.3 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.8 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, and as indicated.

.3 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.5 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.4 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code, Provincial Code, and authority having jurisdiction.

.2 Gas piping: up to NPS 1/2: every 1.8 m.

.3 Copper piping: up to NPS 1/2: every 1.5 m.

.4 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

3.5 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.6 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.7 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.8 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components and their installation.

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

.2 National Building Code of Canada (NBC) - 2015

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

.2 Waste Management and Disposal:

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

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.2 GENERAL

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

2.3 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.4 ELASTOMERIC MOUNTS

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

2.5 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Colour code springs.

2.6 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Performance: as indicated.

2.7 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut.

.6 Performance: as indicated.

2.8 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

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

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturers' instructions and adjust mountings to level equipment.

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

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

.1 Up to NPS4: first 3 points of support.

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

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

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

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-15, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

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

.3 Product data to include paint colour chips, other products specified in this section.

1.5 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

.2 Waste Management and Disposal:

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

.2 Dispose of unused paint and/or coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint or coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 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, 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 Identification for Departmental Representative Preventive Maintenance Support System (PMSS)::

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

2.4 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.5 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

2.6 IDENTIFICATION OF PIPING SYSTEMS

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

.2 Pictograms:

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

.3 Legend:

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

.4 Arrows showing direction of flow:

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

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

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

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

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

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

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

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

.7 Colours and Legends:

.1 Where not listed, obtain direction from 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
City water	Green	CITY WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Engine exhaust	Yellow	ENGINE EXHAUST
Natural gas	to Codes	
Gas regulator vents	to Codes	

2.7 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.8 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.9 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.

2.10 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 EXISTING SYSTEMS

.1 For existing systems and equipment not modified by this contract, the existing identification scheme is to remain.

3.2 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.3 MANUFACTURER'S INSTRUCTIONS

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

3.4 TIMING

.1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.5 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC or CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to Departmental Representative PMSS.

3.6 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.7 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.8 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.9 THERMOSTATS

.1 Provide tag at each thermostat identifying the associated equipment (baseboard / radiant panel / reheat coil) and thermal zone / room number(s); conceal tag behind thermostat cover.

3.10 FIELD QUALITY CONTROL

.1 Not used.

3.11 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

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

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

.3 All TAB work is to be carried out in coordination with the activities of the commissioning agent as described in Section 01 91 13 - General Commissioning (Cx).

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 QUALIFICATIONS OF TAB PERSONNEL

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

.2 Provide documentation confirming qualifications, successful experience.

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

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

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

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

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

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

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

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 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.

1.5 EXCEPTIONS

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

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 Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.9 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.10 START OF TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.11 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5 %, minus 5 %.

.2 Hydronic systems: plus or minus 10 %.

1.12 ACCURACY TOLERANCES

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

1.13 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.14 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 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.

1.16 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 3 copies of TAB Report to Departmental Representative for verification and approval, in English, in D-ring binders, complete with index tabs.

1.17 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.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

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

1.20 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section and the TAB standards of NEBB, ASHRAE.

.2 Do TAB of systems, equipment, components, controls specified Division 23.

.3 Qualifications: personnel performing TAB current member in good standing of NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified by NEBB.

.5 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.

.6 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Definitions:

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.2 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

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

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.4 Samples:

.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.

.2 Mount sample on 12 mm plywood board.

.3 Affix typewritten label beneath sample indicating service.

.5 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.2 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with or without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with or without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.4 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:

.1 To ASTM B209 with or without moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Smooth.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

.4 Stainless steel:

.1 Type: 304.

.2 Thickness: 0.25 mm sheet.

.3 Finish: Smooth.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.5 ACCESSORIES

.1 Vapour retarder lap adhesive:

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

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face of insulation.

.12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 APPLICATION

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

3.3 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.4 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.5 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing plenum	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Acoustically lined ducts	none		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.3 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.4 ASTM C547-07, Standard Specification for Mineral Fiber Pipe Insulation.

.5 ASTM C553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.6 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

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

.1 Material Safety Data Sheets (MSDS).

.5 Thermal Insulation Association of Canada (TIAC)

.1 National Insulation Standards 2005.

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Manufacturer's Instructions:

.1 Include procedures to be used and installation standards to be achieved.

.4 Qualifications:

.1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Store at temperatures and conditions recommended by manufacturer.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 COMPONENTS

.1 Not used.

2.2 FIRE AND SMOKE RATING

.1 Fire and smoke ratings to CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Maximum "k" factor: ASTM C547.

.4 TIAC Code C-1: rigid mineral fibre board, unfaced.

.1 Mineral fibre: ASTM C612.

.2 Maximum "k" factor: ASTM C612.

.5 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: ASTM C553.

.2 Jacket: to CGSB 51-GP-52MA.

.3 Maximum "k" factor: ASTM C553.

.6 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: ASTM C533.

.2 Maximum "k" factor: ASTM C533.

.3 Design to permit periodic removal and re-installation.

2.4 CEMENT

.1 Thermal insulating and finish

.1 To: ASTM C449/C449M.

.2 Hydraulic setting on mineral wool, to ASTM C449.

2.5 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type to CAN/CGSB 51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.7 Special requirements:

.1 Outdoor: UV rated material at least 0.5 mm thick.

.8 Covering adhesive: compatible with insulation.

.2 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: smooth.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

.4 Stainless steel:

.1 Type: 304.

.2 Thickness: 0.25 mm.

.3 Finish: smooth.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

2.6 INSULATION SECUREMENTS

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

.6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation with expanded metal lath on other face.

.7 Fasteners: 2 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 APPLICATION

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

3.3 PRE- INSTALLATION REQUIREMENTS

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

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

3.4 INSTALLATION

.1 Install in accordance with TIAC National Standards

.1 Hot equipment: To TIAC code 1503-H.

.2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.4 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports outside vapour retarder jacket.

.6 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.5 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: At expansion joints, valves, flanges and unions at equipment.

.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.6 EQUIPMENT INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Hot Equipment:

.1 TIAC code A-1 with bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC code C-2 unfaced with bands and 13 mm cement preceded by one layer of reinforcing mesh.

.3 Breechings, engine exhausts and mufflers:

.1 TIAC code A-2 with 25 mm air gap, mechanical fastenings and 13 mm cement reinforced with one layer of reinforcing mesh.

.4 Finishes:

.1 Engines exhaust piping and muffler: To TIAC code CRF-4.

.2 Equipment in mechanical rooms: TIAC code CEF/1 with jacket.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-2003, Mineral Fiber Pipe Insulation.

.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

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

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.4 Samples:

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

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 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.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

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

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

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

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.2 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 PRE-INSTALLATION REQUIREMENT

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

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

3.4 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.5 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at valves, flanges and unions at equipment.

.2 Design: to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC or high temperature fabric.

3.6 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.7 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements: Tape.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees (°C)	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8
Boiler Feed Water		A-1	25	25	25	25	25	25
Hot Water Heating	60 - 94	A-1	25	38	38	38	38	38
RWL and RWP		C-2	25	25	25	25	25	25

.5 Finishes:

.1 Exposed indoors: canvas jacket.

.2 Exposed in mechanical rooms: canvas jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.8 FIELD QUALITY CONTROL

.1 Not used.

3.9 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Not used.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

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

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Boiler chiller operation.

.3 Pressure bypass open/closed.

.4 Control pressure failure.

.5 Maximum heating demand.

.6 Boiler chiller failure.

.7 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or

.2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heating coil and radiation control valves.

.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

.3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.6 GASEOUS FUEL 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.

1.7 REPORTS

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

1.8 TRAINING

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 RELATED REQUIREMENTS

.1 Not used.

1.3 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

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

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Not used.

2.2 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 CLEANING HYDRONIC SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Extent: clean all hydronic systems, including both new and existing pipework.

.3 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.4 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.5 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.6 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.7 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.8 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to 82 degrees C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.4 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.5 FIELD QUALITY CONTROL

.1 Not used.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 RELATED REQUIREMENTS

.1 Not used.

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, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1-96, 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-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.

.4 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 B149.1HB-00, Natural Gas and Propane Installation Code Handbook.

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

.1 Material Safety Data Sheets (MSDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Indicate on manufacturer’s catalogue literature following: valves.

.3 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials.

.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 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

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

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

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan (WMP).

.5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Not used.

2.2 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.

2.3 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Brazing: to ASTM B837.

2.4 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.

2.5 VALVES

.1 Provincial Code approved, lubricated plug type.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 PIPING

.1 Install in accordance with Section 23 05 05 - Installation of Pipework, applicable Provincial/Territorial Codes, and CAN/CSA B149.1, supplemented as specified.

.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.4 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

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 Obtain reports within 3 days of review and submit immediately to Consultant.

.3 Performance Verification:

.1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

.4 PV procedures:

.1 Test performance of components.

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 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems, CAN/CSA B149.1, supplemented as specified.

.2 Perform cleaning operations as specified and 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 REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)

.1 ANSI/AWS A5.8/A5.8M-11, AMD1 Specification Filler Metals for Brazing and Braze Welding.

.2 ASME

.1 ANSI/ASME B16.4-06, Gray-Iron Threaded Fittings Classes 125 and 250.

.2 ANSI/ASME B16.15-11, Cast Copper Alloy Threaded Fittings Classes 125 and 250.

.3 ANSI B16.18-12, Cast Copper Alloy, Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.22-12, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 ASTM International

.1 ASTM B32-08, Standard Specification for Solder Metal.

.2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.

.3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric.

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

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturers Standardization Society (MSS)

.1 MSS SP70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS SP71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.3 MSS SP80-2008, Bronze Gate, Globe, Angle and Check Valves.

.4 MSS SP85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

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 hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.2 Indicate on manufacturer’s catalogue literature the following: valves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

1.5 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Materials:

.1 Furnish following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial /Territorial regulations.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 TUBING

.1 Type K hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.5 VALVES

.1 Connections:

- .1 NPS 2 and smaller: ends for soldering.
- .2 NPS 2 1/2 and larger: flanged ends.

.2 Globe valves: application: throttling, flow control, emergency bypass:

- .1 NPS 2 and under:
  - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
  - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 1/2 and over:
  - .1 With composition disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.

.3 Balancing, for TAB:

- .1 Sizes: calibrated balancing valves, as specified.
- .2 NPS 2 and under:
  - .1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.4 Swing check valves:

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.5 Ball valves:

.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

.6 Lubricated Plug Valves:

.1 As specified Section 23 05 23.02 - Valves - Cast Iron.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.4 VALVE INSTALLATION

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

.2 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install globe valves for balancing and as indicated.

.4 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

.5 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms.

3.5 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and / or flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.6 FLUSHING AND CLEANING

.1 Flush and clean in presence of Departmental Representative.

.2 Flush after pressure test for a minimum of 4 hours.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.

.4 Refill system with clean water. Circulate for at least 4 hours. Clean out strainer screens/baskets regularly. Then drain.

.5 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.

.6 Drainage to include drain valves, dirt pockets, strainers, low points in system.

.7 Re-install strainer screens/baskets only after obtaining Departmental Representative's approval.

3.7 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment as specified.

3.8 FIELD QUALITY CONTROL

.1 Testing:

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

.2 Balancing:

.1 Balance water systems to within plus or minus 5% of design output.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition 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 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.

.4 ASME B16.9-07, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).

.6 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.3 ASTM International

.1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.

.4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 CSA International

.1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)

.1 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.

.3 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.

.4 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

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 hydronic systems 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 Province of Alberta, Canada.

.2 Indicate on drawings:

.1 Components and accessories.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

.1 Include special servicing requirements.

1.5 EXTRA STOCK MATERIALS

.1 Supply spare parts as follows:

.1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.

.2 Discs: 1 minimum for every ten valves, each size. Minimum one.

.3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.

.4 Valve handles: 2 minimum of each size.

.5 Gaskets for flanges: 1 minimum for every ten flanges.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Roll grooved: standard coupling to CSA B242.

.4 Flanges: raised face, weld neck to ANSI/AWWA C111/ A21.11.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to ANSI/AWWA C111/ A21.11.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1.

.9 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M, ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M ductile iron to ASTM A536.

2.4 VALVES

.1 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2-1/2 and larger: flanged or grooved ends.

.2 Globe valves: to application: throttling, flow control, emergency bypass:

.1 NPS 2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2-1/2 and over:

.1 With composition disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.

.3 Balancing, for TAB:

.1 Sizes: calibrated balancing valves, as specified this section.

.2 NPS 2 and under:

.1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.4 Swing check valves: to MSS-SP-71.

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2-1/2 and over:

.1 Flanged or Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.5 Ball valves:

.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

.6 Lubricated Plug Valves

.1 As specified Section 23 05 23.02 - Valves - Cast Iron.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.3 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

3.4 CLEANING, FLUSHING AND START-UP

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

3.5 TESTING

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

3.6 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.7 PERFORMANCE VERIFICATION

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

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

3.9 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.

.2 ASTM International

.1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 CSA Group

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

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 expansion tanks, air vents, separators, valves, and strainers 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 Province of Alberta, Canada.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic specialties from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical steel pressurized diaphragm type expansion tank.

.2 Capacity: as indicated.

.3 Size: as indicated.

.4 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.5 Working pressure: 860 kPa with ASME stamp and certification.

.6 Air precharged to 84 kPa (initial fill pressure of system).

.7 Base mount for vertical installation.

.8 Supports: provide supports with hold down bolts and installation templates.

.9 Renewable diaphragm.

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 690 kPa working pressure.

2.3 AIR SEPARATOR - BOILER MOUNTED

.1 Complete with dip tube.

.2 Working pressure: 860 kPa.

2.4 AIR SEPARATOR - EXPANSION TANK FITTING

.1 Complete with adjustable vent tube and built-in manual vent valve.

.2 Working pressure: 860 kPa.

2.5 AIR SEPARATOR - IN-LINE

.1 Working pressure: 860 kPa.

.2 Size: as indicated.

2.6 COMBINATION SEPARATORS/STRAINERS

.1 Steel, tested and stamped in accordance with ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.7 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, solder end connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A278/A278M, Class 30, flanged connections.

.3 Blowdown connection: NPS 1.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 860 kPa.

2.8 SUCTION DIFFUSER

.1 Body: cast iron with flanged connections.

.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure gauge tappings.

.6 Adjustable support leg.

2.1 ACCEPTABLE MANUFACTURERS

.1 Amtrol

.2 Armstrong

.3 ITT

.4 Taco

.5 Grundfos

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

3.5 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.6 EXPANSION TANKS

.1 Adjust expansion tank pressure as indicated or to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.7 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.8 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition 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 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 CSA Group

.1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1-2011, Motors and Generators.

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 pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 EQUIPMENT

.1 Size and select components to: CAN/CSA-B214.

2.2 IN-LINE CIRCULATORS

.1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: alloy steel, cast bronze, cast iron or stainless steel.

.3 Shaft: alloy or stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 degrees C.

.5 Coupling: rigid self-aligning.

.6 Motor: to NEMA MG 1 resilient mounted, sleeve bearing, and as indicated; provide inverter duty motor where pump is variable speed drive.

.7 Capacity: as indicated.

.8 Design pressure: as indicated.

2.3 VERTICAL IN-LINE CIRCULATORS

.1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.

.2 Impeller: corrosion resistant steel, brass or bronze.

.3 Shaft: alloy or stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 degrees C.

.5 Coupling: flexible self-aligning.

.6 Motor: to NEMA MG 1 resilient mounted, drip proof, sleeve bearing, and as indicated; provide inverter duty motor where pump is variable speed drive.

.7 Capacity: as indicated.

.8 Design pressure: as indicated.

2.4 ACCEPTABLE MANUFACTURERS

.1 Armstrong

.2 Grundfos

.3 ITT

.4 Taco

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

.1 Install hydronic pumps to: CAN/CSA-B214.

.2 In line circulators: install as indicated by flow arrows.

.1 Support at inlet and outlet flanges or unions.

.2 Install with bearing lubrication points accessible.

.3 Base mounted type: supply templates for anchor bolt placement.

.1 Include anchor bolts with sleeves. Place level, shim unit and grout.

.2 Align coupling in accordance with manufacturer's recommended tolerance.

.3 Check oil level and lubricate. After run-in, tighten glands.

.4 Ensure that pump body does not support piping or equipment.

.1 Provide stanchions or hangers for this purpose.

.2 Refer to manufacturer's installation instructions for details.

.5 Provide pipe size shut off valve and strainer on suction, pipe size spring loaded check valve and valve for throttling on discharge. Factory designed combination valve inlet and discharge fittings may be used if certified by pump manufacturer.

.6 Decrease from pipe size with long radius reducing elbows or reducers. Install to Hydraulic Institute recommended practices. Disconnect the coupling once the unit has been placed on the foundation. Start piping installation from the pump and do not connect a pump to piping Reconnect the coupling only after final piping, alignment and rotation has been performed. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge with anchors near, but independent of the pump. Make sure piping exerts no strain on the pump that could cause casing distortion or pump misalignment.

.7 Vertical in-lines shall be free to float with expansion and contraction of the piping. The pumps shall be supported at ceiling by spring type isolation pipe hangers with additional floor mounted supports under suction and discharge elbows, alternatively under manufacturer supplied suction guides and flo-trex valves. Where flo-trex valves are utilized on pump discharge, they are to be line-size and there shall be a minimum 2 to 5 times increaser/reducer or spool piece installed between pump discharge and flo-trex valve. Where suction guides are not used, a strainer of three to four times the area of the suction pipe shall be installed. A straight pipe of equivalent of 4 to 6 times the pump diameter shall be provided

.8 Support pipe adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge lines 100 mm and over.

.9 Where pipe rises more than 1000 mm before being supported, use spring type supports on systems operating at more that 50°C differential from ambient temperature for lines 75 mm and over.

.10 Pipe drain tapping to drain.

.11 Install volute venting pet cock in accessible location.

.12 Check rotation prior to start-up.

.13 Install pressure gauge test cocks.

.14 Provide variable frequency drives in accordance with Section 23 81 05 for variable speed pumps.

3.4 START-UP

.1 General:

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

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours minimum.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in Section 01 91 13 - General Commissioning (Cx) Requirements.

.3 Where procedures do not exist, discontinue PV, report to Consultant and await instructions.

.5 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:

.1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Use Report Forms specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

.3 Pump performance curves (family of curves).

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition 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 RELATED REQUIREMENTS

.1 Not used.

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 Green Seal Environmental Standards (GS)

.1 GS-36-11, Standard for Adhesives for Commercial Use.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 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.

.3 IAQ Guideline for Occupied Buildings Under Construction 2007.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

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 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.4 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 Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition 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
63	Unsealed

.2 Seal classification:

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

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape, or combination thereof. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

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

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

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

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius, centreline radius: 1.5 times width of duct, or short radius with single thickness turning vanes.

.2 Round: five piece, centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with 45 degrees entry on branch or radius on branch 1.5 times width of duct.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Short radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.8 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA

.4 Upper hanger attachments:

.1 For steel joist: manufactured joist clamp.

.2 For steel beams: manufactured beam clamp.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 GENERAL

.1 Do work in accordance with SMACNA and as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Install breakaway joints in ductwork on sides of fire separation.

.4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.5 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: in accordance with SMACNA

3.4 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition 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 RELATED REQUIREMENTS

.1 Not used.

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 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 air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Flexible Connections:

- .1 Install in following locations:
  - .1 Inlets and outlets to supply air units and fans.
  - .2 Inlets and outlets of exhaust and return air fans.
  - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
  - .1 Ducting on sides of flexible connection to be in alignment.
  - .2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

- .1 Size:
  - .1 400 x 400 mm for servicing entry.
  - .2 200 x 200 mm for viewing.
  - .3 As indicated.
- .2 Locations:
  - .1 Fire dampers.
  - .2 Control dampers.
  - .3 Devices requiring maintenance.
  - .4 Required by code.
  - .5 Reheat coils.
  - .6 Elsewhere as indicated.

.3 Instrument Test Ports:

- .1 General:
  - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate to permit easy manipulation of instruments.
- .3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by 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.

.4 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition 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 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon or bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: as indicated.

.4 Bearings: pin in bronze bushings or self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Corrections and adjustments conducted by Departmental Representative.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition 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 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel or extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Performance:

.1 Leakage: in closed position less than 2% of rated airs flow at 249 Pa differential across damper.

.2 Pressure drop: at full open position less than 13 Pa differential across damper at 5.0 m/s.

.6 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted, counterweighted, as indicated.

2.3 RELIEF DAMPERS

.1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at static pressure as indicated.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.

.2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.

.3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

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 fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate the following:

.1 Fire dampers.

.2 Fusible links.

.3 Design details of break-away joints.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for fire dampers for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide:

.1 6 fusible links of each type.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B and C only, listed, meet requirements of authorities having jurisdiction, provincial fire authority and NFPA 90A. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: offset single damper, round or square; multi-blade hinged interlocking type; sized to maintain full duct cross section as indicated.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Co-ordinate with installer of fire stopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 ASTM International

.1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.2 ASTM C916-85(2007), Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C1071-12, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.4 ASTM C1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.5 ASTM G21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.3 North American Insulation Manufacturers Association (NAIMA)

.1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.

.4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible-2005.

.2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-2007.

.5 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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 duct liners and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for duct liners for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 DUCT LINER

.1 General:

.1 Mineral Fibre duct liner: air surface coated mat facing.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with NFPA 90A.

.3 Fungi resistance: to ASTM C1338.

.2 Rigid:

.1 Use on flat surfaces.

.2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.

.3 Density: 48 kg/m^3minimum.

.4 Thermal resistance to be minimum 0.76 (m^2. degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.

.5 Maximum velocity on faced air side: 20.3 m/s.

.6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.

.3 Flexible:

.1 Use on round or oval surfaces.

.2 25 mm thick, to ASTM C1071 Type 1, fibrous glass blanket duct liner.

.3 Density: 24 kg/m^3 minimum.

.4 Thermal resistance to be minimum 0.37 (m^2.degrees C)/W for 12 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.

.5 Maximum velocity on coated air side: 25.4 m/s.

.6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

2.2 ADHESIVE

.1 Adhesive: to NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.

.3 Water-based type.

2.3 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

.1 Meet requirements of NFPA 90A.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 GENERAL

.1 Do work in accordance with SMACNA HVAC Duct Construction Standard except as specified otherwise.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

3.3 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916.

.1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.

.2 In addition to adhesive, install impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.

.1 Spacing of mechanical fasteners in accordance with SMAC HVAC Duct Construction Standard.

.2 In systems, where air velocities exceed 20.3 m/s, install galvanized sheet metal noising to leading edges of duct liner.

3.4 JOINTS

.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply 2 coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Consultant.

.3 Protect leading edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 99-2010, Standards Handbook.

.2 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #18, Primer, Zinc Rich, Organic.

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 drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

.2 Provide:

.1 Fan performance curves showing point of operation, bhp and efficiency.

.2 Sound rating data at point of operation.

.3 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with variable speed controllers as appropriate.

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 in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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, 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.

.4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210.

2.2 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers as indicated.

.3 Sizes as indicated.

.2 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.

.7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

.8 Gravity backdraft dampers: as indicated.

.9 Motorized backdraft dampers: to Section 25 30 02 – EMCS: Field Control Devices and Section 25 90 01 – EMCS: Site Requirements, Applications, and Systems Sequences of Operation.

2.3 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded steel construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Air foil, forward curved, or backward inclined blades, as indicated.

.2 Bearings: split pillow-block grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel or aluminum for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide latched airtight access doors with handles.

2.4 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators, motor, drive as indicated, and casing.

.3 Fabricate casing of zinc coated or phosphate treated steel of thickness as indicated 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.

2.5 UTILITY SETS

.1 Characteristics and construction: as for centrifugal fans.

.2 Preassemble single width centrifugal fan with removable weatherproof protective hood with vents, and automatic motorized dampers and 12 mm mesh bird screens.

.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.6 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and drive as indicated.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.7 ACCEPTABLE MANUFACTURERS

.1 Greenheck

.2 Penn Barry

.3 Twin City

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration 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 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Conference of Governmental Industrial Hygienists (ACGIH)

.1 ACGIH 2095, Industrial Ventilation: A Manual of Recommended Practice for Design, 26th Edition.

.2 ASTM International

.1 ASTM C700-13, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.

.3 National Fire Protection Association (NFPA)

.1 NFPA 91-10, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Non-combustible Particulate Solids.

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 fans 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 Province of Alberta, Canada.

.2 Indicate following:

.1 Fan performance curves.

.2 Inlet details.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit list of manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 INLETS

.1 Type of inlets: overhead as indicated.

2.2 FANS

.1 Backward inclined wheel, belt driven, electric motor complete with disconnect switch at motor and controlled by existing remote push button switch. Airflow, pressure, RPM, and motor size as indicated.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install in accordance with NFPA 91, and to manufacturer’s instructions.

.2 Follow ACGIH industrial ventilation details.

.3 Make joints watertight and airtight when subjected to 1.5 kPa pressure.

3.3 TESTING

.1 Test assembled and sealed ductwork from fan inlet to suction inlets under 2.5 kPa pressure for 30 minutes.

.1 Leakage not to exceed 1% of design total air flow.

.2 Test apparatus to include calibrated orifice and manometer.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Not used.

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 diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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.

2.2 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: standard.

2.3 MANUFACTURED UNITS

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

2.4 GRILLES, REGISTERS, AND DIFFUSERS

.1 As indicated.

2.5 ACCEPTABLE MANUFACTURERS

.1 E.H. Price

.2 Nailor

.3 Titus

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 ASTM International

.1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.3 Society of Automotive Engineers (SAE)

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 louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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.

2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured aluminum, hinged at curb line.

.1 Complete with integral bird screen of 2.7 mm diameter aluminum wire.

.2 Horizontal backdraft dampers on 4 faces.

.3 Maximum throat velocity: 3.3 m/s intake.

.4 Maximum loss through unit: 15 Pa exhaust static pressure.

.5 Maximum velocity through damper area: 1.5 m/s.

.6 Shape: as indicated.

.2 Bird screens:

.1 Complete with integral bird screen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust and 19 mm mesh on intake.

2.3 GOOSENECK HOODS

.1 Thickness: to SMACNA.

.2 Fabrication: to SMACNA.

.3 Joints: to SMACNA.

.4 Supports: as indicated.

.5 Complete with integral bird screen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.

.6 Backdraft dampers at roof penetration.

2.4 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 12 mm exhaust and 19 mm intake mesh, 2 mm diameter wire aluminum bird screen on inside face of louvres in formed U-frame.

.8 Finish: factory applied enamel or anodized. Colour: to Departmental Representative's approval.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 52.2-12, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.

.3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.

.4 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.5 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

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 filters 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 Province of Alberta, Canada.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

.3 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between -40 and 50 degrees C.

.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

.1 Holding frames: permanent channel section construction of same material as casing/hood, 1.6 mm thick, except where specified.

.2 Seals: to ensure leak-proof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on each side and/or from downstream face of filter bank.

2.3 RIGID, SUPPORTED BAG TYPE FILTERS, 30-35 % EFFICIENCY

.1 Media: disposable preformed fibrous glass or acrylic fibre cartridge.

.2 Holding frame: galvanized steel with bracing.

.3 Media support: welded wire grid.

.4 Performance:

.1 Average atmospheric dust spot efficiency 30% to ANSI/ASHRAE 52.2.

.5 Fire rated: to ULC -S111.

2.4 CARTRIDGE TYPE FILTERS, 80-85% EFFICIENCY

.1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.

.2 Holding frame: galvanized steel with bracing.

.3 Media support: welded wire grid.

.4 Performance: average atmospheric dust spot efficiency 80-85% to ANSI/ASHRAE 52.2.

.5 Fire rated: to ULC -S111.

2.5 FILTER GAUGES - DIAL TYPE

.1 Diaphragm actuated, direct reading.

.2 Range: 0 to 250 Pa.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION GENERAL

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 REPLACEMENT MEDIA

.1 Replace media with new upon acceptance.

.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 FILTER GAUGES

.1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.

.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

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 chimneys and stacks 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 Province of Alberta, Canada.

.2 Indicate following:

.1 Methods of sealing sections.

.2 Methods of expansion.

.3 Details of thimbles.

.4 Bases/Foundations.

.5 Supports.

.6 Guy details.

.7 Rain caps.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations.

.2 Certifications:

.1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 BREECHINGS

.1 Shop fabricated 3.5 mm thick stainless steel welded, with sweep bends from boiler outlet to thimble or chimney as indicated.

2.2 FUELS: PRESSURE CHIMNEY AND BREECHING

.1 ULC labelled, 760 degrees C rated.

.2 Sectional, prefabricated, double wall with air space with mated fittings and couplings.

.1 Liner: type 304 stainless steel, thickness to suit application.

.2 Shell: aluminized steel, to suit application.

.3 Outer seals between sections: to suit application.

.4 Inner seals between sections: to suit application.

2.3 TYPE B GAS VENT

.1 ULC labelled, 288 degrees C rating maximum, atmospheric gas vent only.

.2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

2.4 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching, as indicated.

.2 Barometric dampers: single acting, 70% of full size of breeching area.

.3 Hangers and supports: in accordance with recommendations SMACNA.

.4 Rain cap.

.5 Expansion sleeves with heat resistant caulking, held in place as indicated.

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at 1.5 m centres and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels as indicated.

.4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.5 Install flashings on chimneys penetrating roofs, as indicated.

.6 Install rain caps and cleanouts, as indicated.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 REFERENCES

.1 American Boiler Manufacturers Association (ABMA)

.2 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.

.3 CSA Group

.1 CAN1-3.1-77(R2011), Industrial and Commercial Gas-Fired Package Boilers.

.2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

.3 CSA B149.1-10, Natural Gas and Propane Installation Code.

.4 ANSI Z21.13-10/CSA 4.9-10, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

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 heating boilers 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 Province of Alberta, Canada.

.2 Indicate on drawings:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Foundations with loadings, anchor bolt arrangements.

.4 Piping hook-ups.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 All miscellaneous equipment.

.8 Flame safety control system.

.9 Breeching and stack configuration.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100%, and 110% of design capacity.

.2 Radiant heat loss at 100% design capacity.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra materials:

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.1 Special tools for burners, access opening, handholes and Operation and Maintenance.

.2 Spare parts for 1 year of operation.

.3 Spare gaskets.

.4 Spare gauge glass inserts.

.5 Probes and sealants for electronic indication.

.6 Spare burner tips.

.7 Spare burner gun.

.8 Safety valve test gauge.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Packaged boiler:

- .1 Complete with linkage-less modulating burner and necessary accessories and controls.
- .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA B140.7.
- .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
- .4 Designed and constructed to ASME Boiler and Pressure vessel Code.
- .5 CRN (Canadian Registration Number), to CSA B51.
- .6 Boiler/burner package to bear ULC label.

.2 Performance:

- .1 In accordance with American Boiler Manufacturers Association (ABMA), or ANSI Z21.13/CSA 4.9 (gas burning) testing procedures.
- .2 Hot water: output, supply and return temperatures as indicated; 830 kPa maximum operating pressure.
- .3 Boiler efficiency: 85% minimum at 30% to 100% firing rates.
- .4 Flue gas temperature leaving boiler:
  - .1 Not to exceed 260 degrees C.
  - .2 Above dewpoint conditions at minimum firing rate.

.3 Electrical:

- .1 Power: 208 V, 3 phase, 60 Hz.
- .2 Controls: 120 V, 1 phase, 60 Hz.
- .3 Pump starter and hand/off/auto for associated boiler pump.
- .4 Electrical components: CSA approved.

.4 Controls:

- .1 Factory wired. Enclosed in EEMAC 1 steel cabinet.
- .2 BACnet compatible card interface.
- .3 Staging controller.

.5 Thermal insulation:

- .1 50 mm thick mineral fibre. Seal insulation at handholes, access opening, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.

.6 Jackets: heavy gauge metal, finished with heat resisting paint.

.7 Mounting:

- .1 Structural steel base, lifting lugs.

.8 Anchor bolts and templates:

.1 Supply for installation by other Divisions. Anchor bolts to be sized to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.

.9 Start-up, instruction, on-site performance tests: 3 days per boiler.

.10 Trial usage:

.1 Consultant may use boilers for test purposes prior to acceptance and commencement of warranty period.

.2 Supply labour, materials and instruments required for tests.

.11 Temporary use by contractor:

.1 Contractor may use boilers only after written approval from Departmental Representative.

.2 Monitor and record performance continuously. Keep log of maintenance activities carried out.

.3 Refurbish to as-new condition before final inspection and acceptance.

2.2 CAST IRON BOILER

.1 Sectional forced draft firing, water wall design, complete with factory assembled and / or site assembled sections, front plate and removable panels.

.2 Design of sections to provide balanced water circulation and flue gas travel. Make sections gas-tight and water-tight through use of high temperature rope, nipples, pull-up bolts.

.3 Flue passages: readily accessible without use of special tools.

.4 Provide supply and return headers, elbows to manufacturer’s recommendations and to suit installation.

.5 Include mudholes, inspection and cleanout handholes.

2.3 AUXILIARIES

.1 Provide auxiliaries for each boiler and to meet ASME requirements.

.2 Hot water boilers:

.1 Relief valves: ASME rated, set at 345 kPa, to release entire boiler capacity.

.2 Pressure gauge: 90 mm diameter complete with shut-off cock.

.3 Thermometer: 115 mm diameter range 10 to 150 degrees C.

.4 Low water cut-off: with visual and audible alarms.

.5 Auxiliary low water cut-off: with separate cold water connection to boiler.

.6 Isolating gate valves: on supply and return connections.

.7 Drain valve: NPS 2.

.8 Stack thermometer: range 65 to 400 degrees C.

.9 Outdoor controller: to reset operating temperature controller.

.10 1 set of cleaning tools.

.3 Pot type chemical feeder.

2.4 EMISSION CONTROL

.1 Rate of discharge of air contaminants from boiler not to exceed:

.1 For nitrogen oxides expressed as nitrogen dioxide:

.1 22 ng/J of heat input when fired with gaseous fuel.

.2 For carbon monoxide, 125 ng/J of heat input.

2.5 ACCEPTABLE MANUFACTURERS

.1 Burnham

.2 Viessman

.3 Weil-McLain

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of authority having jurisdiction, except where specified otherwise, and manufacturers recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.

.5 Pipe hot water relief valves full size to nearest drain.

.6 Pipe drain to floor drain.

.7 Natural gas fired installations: in accordance with CSA B149.1.

.8 Coordinate with the controls contractor to provide end-to-end commissioning of all hardwired and mapped points that are listed in section 25 90 02.

3.4 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves:

.1 Run separate discharge from each valve.

.2 Terminate discharge pipe as indicated.

.3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

.2 Blowdown valves:

.1 Run discharge to terminate as indicated.

3.5 FIELD QUALITY CONTROL

.1 Commissioning:

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

.2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not used.

1.2 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.

1.3 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 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 Province of Alberta, 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.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for outdoor HVAC equipment 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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 WARRANTY

.1 For Work of this Section 23 74 00 - Packaged Outdoor HVAC Equipment, 12 months warranty period is extended to 60 months.

.2 Contractor hereby warrants that packaged rooftop HAVC units and refrigeration compressors will function and operate in accordance with CCDC 2 GC 24, but for 60 months.

Part 2 Products

2.1 GENERAL

.1 Roof mounted, self-contained single zone unit with gas burner and DX refrigeration and bear label of CSA and / or ULC.

.2 Units to consist of cabinet and frame, supply fan, heat exchanger, burner with integral induced draft fan, heater control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, motorized exhaust damper.

.3 Prefabricated roof curb to conform to requirements of National Roofing Contractors Association (NRCA), minimum height 450 mm.

.4 Conform to ANSI/AHRI 210/240, rating for unit larger than 40 kW nominal.

2.2 CABINET

.1 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to AHRI 270.

.2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs.

.3 Outer casing: weathertight 1.0 mm thick galvanized steel with baked enamel finish, complete with flashing.

.4 Access: gasketted hinged doors and panels with locking door handle type fasteners.

.5 Insulation: neoprene coated glass fiber on surfaces 50 mm thick, 32 kg/m^3 density.

2.3 FANS

.1 Centrifugal, forward curved impellers, statically and dynamically balanced. V-belt drive with adjustable variable pitch motor pulley, fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators spring isolated hinge mounted motor. Vibration isolators: 95% efficiency.

2.4 AIR FILTERS

.1 50 mm thick, 85% efficiency, metal framed, throwaway, standard to unit manufacturer.

.2 To meet NFPA 90A, air filter requirements type Class 1.

2.5 HEAT EXCHANGERS AND BURNERS

.1 Gas fired, multiple flue passes, with primary heating surface of aluminized stainless steel.

.1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.

.2 Forced draft type.

.3 Spark ignited pilot with pilot flame safety shut-off.

2.6 REFRIGERATION

.1 Conform to CSA B52 and UL 1995 requirements.

.2 Compressor/Condenser Section:

.1 Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater, and automatic pump down system with control to liquid line solenoid valve.

.2 Fan: propeller type with single piece spun venturi outlets and zinc plated guards. Motor: sequenced for head pressure control.

.3 Electrical system: complete with operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect, powered convenience outlet.

.4 Include refrigerant piping with automatic hot gas bypass, sight glass, filter and valves.

.5 Condenser: staggered copper tube aluminum fin coil assembly with sub-cooling rows.

.6 Capacity reduction: hot gas bypass. Hot gas side port distribution. Provide fan control for head control for low ambient operation down to -10 degrees C ambient temperature.

.7 Refrigerant: R-410A.

.3 Evaporator:

.1 Rated to ANSI/AHRI 210/240.

.2 Thermostatic expansion valve, with adjustable super heat and external equalizer.

.3 Coil: NPS 1/2 od staggered seamless copper tubes expanded into aluminum fins, and insulated condensation pan.

.4 Cooling coil condensate drain pans: designed to avoid standing water, easily cleaned or removable for cleaning. Drain connection: deep seal trap complete with trap seal primer.

2.7 CONTROLS

.1 In addition to combustion safety controls, provide smoke sensors in return to NFPA standards, low limit on supply and freeze protection on steam and water coils.

.2 Mixed Air Single Zone Heat-Cool Unit:

.1 Motorized outside, return and relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and relief air dampers, normally closed.

.2 Tight fitting opposed blade dampers with neoprene or suitable gaskets, bronze bushings and 1% maximum leakage.

.3 Damper operation: 24 V, spring return motor with gear train sealed in oil, and heater for operation under minus 18 degrees C.

.4 Mixed air controls: maintain indicated mixed air temperature, lock out compressor below 10 degrees C ambient, restart 13 degrees C, revert dampers to provide minimum fresh air above 22 degrees C (adjustable).

.3 Night mode: unit cycles as unit heater with 100% recirculation on winter or summer cycles.

.4 Refer to sections 25 90 01 and 25 90 02 for a complete sequence of operation and required BMS interface points.

.5 Provide a BACnet card for connection to the BMS. Refer to 25 90 02 – EMCS Point Schedule for list of points to be provided.

2.8 CAPACITY

.1 As indicated.

2.9 ACCEPTABLE MANUFACTURERS

.1 Carrier

.2 Trane

.3 Lennox

Part 3 Execution

3.1 EXAMINATION

.1 Carry out verification of conditions in accordance with the requirements of Section 21 05 01 – Common Work Results for Mechanical.

3.2 INSTALLATION

.1 Install as per manufacturers' instructions on roof curbs provided by manufacturer.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Run drain line from cooling coil condensate drain pan to discharge onto roof.

.4 Coordinate with the controls contractor to provide end-to-end commissioning of all hardwired and mapped points that are listed in section 25 90 02.

3.3 DEMONSTRATION

.1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

1. General

1.1 SCOPE

.1 Provide infinitely variable speed drive package equipment as specified.

.2 Submit complete service and maintenance manuals including wiring and connection diagrams for review and inclusion in Maintenance Manuals.

1.2 SUBMITTALS

.1 Submit shop drawing information including, but not limited to the following:

.1 CSA approval

.2 Unit tag number and equipment number it serves

.3 Voltage, horsepower

.4 Wiring schematic

.5 Physical dimensions

.6 Copy of start-up and commissioning report

.7 Operation procedures and maintenance

1.3 REFERENCES

.1 IEEE 519-1992, Recommended Practices and Requirements for Harmonic control in Electrical Power System.

.2 FCC Part 15, Class A

.3 UL 508, ETL

.4 National Electrical Manufacturers Association (NEMA) MG1, Part 30

.5 National Electrical Manufacturers Association (NEMA) NEMA MG1, Part 31

.6 Canadian Standards Association (CSA) 22.2, current edition.

.7 UL508C – Standard for Safety for Power Conversion Equipment.

2. Products

2.1. GENERAL

.1 Furnish complete variable frequency drives as specified herein for the pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be NEMA 1 with inlet air filters.

.2 The VFD shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three phase power for stepless motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified on the drawing schedules.

.3 The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage. All VFD's shall include input line reactors.

.4 The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control. The VFD shall maintain a constant V/Hz ratio.

.5 The VFD and options shall be tested to ANSI/UL Standard 508. The complete drive, including all specified options, shall be listed by a nationally recognized testing agency such as cUL/ULC, ETL or CSA.

.6 Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. The total current distortion shall not exceed 5%.

.7 The VFD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules and Regulations, Part 15 for Class A computing devices. The VFD shall carry a FCC compliance label. PWM type drives shall include RFI filters.

.8 Motor noise as a result of the VFD shall be limited to three dB over across the line operation, measured at three feet from the motor's centre line.

.9 Protective Features:

.1 Individual motor overload protection for each motor controlled.

.2 Protection against input power undervoltage, overvoltage, and phase loss.

.3 Protection against output current overload and instantaneous over current.

.4 Protection against overtemperature within the VFD enclosure.

.5 Protection against overvoltage on the DC bus.

.6 Protect VFD from sustained power or phase loss. Undervoltage trip activates automatically when line voltage drops more than 10% below rated input voltage.

.7 Automatically reset faults due to undervoltage, overvoltage, phase loss, or over temperature.

.8 Protection against output short circuit and motor winding shorting to case faults, as defined by UL508.

.9 Status lights or digital display for indication of individual fault conditions.

.10 Controller capable of operating without a motor or any other equipment connected to the drive output to facilitate start-up and troubleshooting.

.11 Input line reactors shall be provided to minimize harmonics introduced to the AC line, and to provide additional protection to AC line transients.

.10 Harmonic Filters

.1 On all motors 3 hp and greater.

.2 A line reactor shall be provided completely factory wired and tested.

.3 An active harmonic filter shall be provided to perform electronic cancellation of load produced harmonic currents such that the upstream power harmonic current and voltage are reduced below the IEEE 519-1992 guidelines for load demand and voltage distortion limits. Performance of the filter shall be independent of the impedance of the power source

.11 Interface Features

.1 Door mounted Hand/Off/Auto selector switch to start and stop the VFD. In the auto position, the VFD will start/stop from a remote contact closure. In the HAND Position, the VFD will run regardless of the remote contact position.

.2 Manual speed control capability.

.3 Local/Remote selector switch. In the remote position, motor speed is determined by the follower signal. In the local position, motor speed is determined by the manual speed control.

.4 Power/on light to indicate that the VFD is receiving utility power.

.5 Fault light to indicate that the VFD has tripped on a fault condition.

.6 Digital meter with selector switch to indicate percent speed and percent load.

.7 A set of form-C, dry contacts to indicate when the VFD is in the run mode.

.8 A set of form-C, dry contacts to indicate when the VFD is in the fault mode.

.9 A 0 to 10Vdc output signal to vary in direct proportion to the controller's speed.

.10 VFD to have terminal strip to accept N.C. safety contacts such as freezestats, smoke alarms, etc. VFD to safely shut down in drive or bypass mode when contacts open.

.11 VFD to accept an additional N.C. contact to interface with the Hand-Off-Auto switch for remote Stop/Start control.

.12 VFD shall accept a4 to 20 mA, 0 to 5Vdc, 0 to 10Vdc signal (as required).

.13 Provide signal follower to interface with the BACnet EMCS.

.12 Adjustments:

.1 Maximum speed, adjustable 50 to 100% base speed.

.2 Minimum speed, adjustable 0 to 50% base speed.

.3 Acceleration time, adjustable 3 to 60 seconds.

.4 Deceleration time, adjustable 3to 60 seconds with override circuit to prevent nuisance trips if decel time is set too short.

.5 Current limit, adjustable 0 to 105%.

.6 Overload trip setpoint.

.7 Offset and gain to condition the input speed signal.

.13 Service Conditions:

.1 Ambient temperature, 32 to 104oF (0 to 40oC).

.2 0 to 95% relative humidity, non-condensing.

.3 Elevation to 3,300 feet (1,000 meters) without derating.

.4 AC line voltage variation, -10 to +10% of nominal.

.14 Special Features:

.1 The following special features shall be included in the VFD enclosure. The unit shall maintain its UL, ETL Listing and CSA certification.

.2 Manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller. The bypass circuitry shall be mounted in a separate section of the VFD enclosure. Motor overload protection shall be provided in both drive and bypass modes.

.3 A door interlocked, pad lockable drive disconnect switch shall be provided to disconnect power from the VFD only.

.4 A second fused disconnect switch or circuit breaker shall be provided as a means of disconnecting all power to both the VFD and bypass circuits, as well as providing short circuit and locked rotor protection to the motor while in the bypass mode.

.5 The disconnect and bypass functions may be accomplished via disconnects, contactors and overloads, or with a four position drive/off/line/test switch with motor starter and bypass fuses.

.15 Quality Assurance:

.1 To ensure quality and minimize infantile failures at the jobsite, the complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and the load and speed shall be cycled during the test.

.2 All optional features shall be functionally tested at the factory for proper operation.

.16 Submittals:

.1 Submit manufacturer's performance data including dimensional drawings, customer connection drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers and catalogue information.

.2 The specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.

3. Execution

3.1 START-UP SERVICE

.1 The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repair shall not be acceptable as commissioning agents.

.2 Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):

.1 Verification of contractor wire terminations to the VFD and its optional circuitry.

.2 Installation verification for proper operation and reliability of the VFD, the motor being driven, and the building automation system.

.3 Up to one hour of customer operator training on operation and service diagnostics at the time of the equipment commissioning.

.4 Measurement for verification of proper operation on each of the following items:

.5 Motor voltage and frequency. Verification of proper motor operation.

.6 Control input for proper building automation system interface and control calibration.

.7 Calibration check for the following set points (and adjustment as necessary) (1) minimum speed, (2) maximum speed, (3) acceleration and deceleration rates.

3.2 WARRANTY

.1 The VFD shall be warranted by the manufacturer. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.

.2 The motor(s) which are directly connected to the VFD shall be warranted by the VFD manufacturer against insulation breakdown which is directly attributed to the VFD. The length of the motor insulation warranty shall be the same as the VFD warranty. The motor must never have been driven by another VFD.

3.3 EXAMINATION

.1 Contractor to verify that jobsite conditions for installation meet factory recommended and code required conditions for VFD installation prior to start-up. These shall include as a minimum:

.1 Clearance spacing.

.2 Temperature, contamination, dust, and moisture of the environment.

.3 Separate conduit installation of the motor wiring, power wiring, and control wiring.

.4 Installation per the manufacturer’s recommendations.

.2 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

.2 Related Requirements

.1 Not used.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01330 - Submittal Procedures.

.2 Final Report: submit report to Departmental Representative.

- .1 Include measurements, final settings and certified test results.
- .2 Bear signature of commissioning technician and supervisor
- .3 Report format to be approved by Departmental Representativebefore commissioning is started.
- .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O M Manuals, and training of O M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Commissioning Manager and in presence of Departmental Representative, at their discretion.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:

- .1 Location and part of system to be tested or commissioned.
- .2 Testing/commissioning procedures, anticipated results.
- .3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Commissioning Manager.

.3 Commission integrated systems using procedures prescribed by Commissioning Manager.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

.1 General: consists of field tests of equipment just prior to installation.

.2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.

.3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.

.4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).

.5 Additional instruments to include:

.1 DP transmitters.

.2 DP switches used for dirty filter indication and fan status.

.6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source.

.7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.

.8 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".

.9 Transmitters above 0.5% error will be rejected.

.10 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and Commissioning Manager and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final startup testing.

.5 O M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30 consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

.5 Commissioning Manager to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Commissioning Manager operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.

.1 List name of trainer, and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within one week after completion of training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

.1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.

.2 Depatmental Representative reserves right to approve instructors.

1.5 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.6 TIME FOR TRAINING

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O M).

1.8 TRAINING PROGRAM

.1 To be in 2 phases over 6 month period.

.2 Phase 1: 1 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative.

.1 Train O M personnel in functional operations and procedures to be employed for system operation.

.2 Supplement with on-the-job training during 30 day test period.

.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.

.4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

.3 Phase 2: 1 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.

.1 Provide multiple instructors on pre-arranged schedule. Include at least following:

.1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.

.2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.3 Programmers: provide personnel with 1 days training within 5 day period in following subjects in approximate percentages of total course shown:

1.9 ADDITIONAL TRAINING

.1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

.1 Departmental Representative to monitor training program and may modify schedule and content.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

.1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1-89(R1995)], Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).

.1 CEA-709.1-B-2002, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

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

.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC).

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

1.3 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level.

.2 AI - Analog Input.

.3 AIT - Agreement on International Trade.

.4 AO - Analog Output.

.5 BACnet - Building Automation and Control Network.
.6 BC(s) - Building Controller(s).
.7 BECC - Building Environmental Control Center.
.8 CAD - Computer Aided Design.
.9 CDL - Control Description Logic.
.10 CDS - Control Design Schematic.
.11 COSV - Change of State or Value.
.12 CPU - Central Processing Unit.
.13 DI - Digital Input.
.14 DO - Digital Output.
.15 DP - Differential Pressure.
.16 ECU - Equipment Control Unit.
.17 EMCS - Energy Monitoring and Control System.
.18 HVAC - Heating, Ventilation, Air Conditioning.
.19 IDE - Interface Device Equipment.
.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.
.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NAFTA - North American Free Trade Agreement.
.26 NC - Normally Closed.
.27 NO - Normally Open.
.28 OS - Operating System.
.29 O M - Operation and Maintenance.
.30 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.
.36 SP - Static Pressure.
.37 ROM - Read Only Memory.
.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.

1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: composed of two parts, point identifier and point expansion.

.1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.

.1 Area descriptor: building or part of building where point is located.

.2 System descriptor: system that point is located on.

.3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.

.2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.

.3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.

.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 Point Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Pulse inputs.

.4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

.2 Refer also to Section 25 05 54- EMCS: Identification.

1.5 SYSTEM DESCRIPTION

.1 Refer to control schematics for system architecture.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

- .1 Building Controllers.
- .2 Control devices as listed in I/O point summary tables.
- .3 OWS(s).
- .4 Data communications equipment necessary to effect EMCS data transmission system.
- .5 Field control devices.
- .6 Software/Hardware complete with full documentation.
- .7 Complete operating and maintenance manuals.
- .8 Training of personnel.
- .9 Acceptance tests, technical support during commissioning, full documentation.
- .10 Wiring interface co-ordination of equipment supplied by others.
- .11 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:

- .1 Design and provide conduit and wiring linking elements of system.
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
- .3 Location of controllers as reviewed by Departmental Representative prior to installation.
- .4 Provide utility power to EMCS power to EMCS as indicated.
- .5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:

- .1 Provide English operator selectable access codes.
- .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
- .3 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
- .4 Include, in English:
  - .1 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English.
  - .2 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures, 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Submit for review:

.1 Equipment list within 10 days after award of contract.

.3 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

.8 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

.1 Have local office within 100 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.5 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.6 Sustainable Requirements:

.1 Construction requirements: in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

.2 Waste Management and Disposal:

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

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

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Label location of salvaged material's storage areas and provide barriers and security devices.

.5 Ensure emptied containers are sealed and stored safely.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 ADAPTORS

.1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified Wood.
- .8 Low-emitting materials.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of local office.

.2 Description and location of installing and servicing technical staff.

.3 Location and qualifications of programming design and programming support staff.

.4 List of spare parts.

.5 Location of spare parts stock.

.6 Names of sub-contractors and site-specific key personnel.

.7 Sketch of site-specific system architecture.

.8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.

.9 Descriptive brochures.

.10 Sample CDL and graphics (systems schematics).

.11 Response time for each type of command and report.

.12 Item-by-item statement of compliance.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Detailed system architecture showing all points associated with each controller including.

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Auxiliary control cabinet locations.

.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

.10 Compressor schematic and sizing data.

1.6 DETAILED SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:

.1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.

.2 Wiring diagrams.

.3 Piping diagrams and hook-ups.

.4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

.5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:

.1 Sensing element type and location.

.2 Transmitter type and range.

.3 Associated field wiring schematics, schedules and terminations.

.4 Complete Point Name Lists.

.5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.8 Input and output signal levels or pressures where new system ties into existing control equipment.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.

.8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.9 Listing and example of specified reports.

.10 Listing of time of day schedules.

.11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.12 Type and size of memory with statement of spare memory capacity.

.13 Full description of software programs provided.

.14 Sample of "Operating Instructions Manual" to be used for training purposes.

.15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for final control diagrams and operation and maintenance (O M) manual, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acryonyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.

.2 Submit As-built drawings to Departmental Representative in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.

.2 Provide index to full volume in each binder.

.3 Identify contents of each manual on cover and spine.

.4 Provide Table of Contents in each manual.

.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

.1 Changes to contract documents as well as addenda and contract extras.

.2 Changes to interface wiring.

.3 Routing of conduit, wiring and control air lines associated with EMCS installation.

.4 Locations of obscure devices to be indicated on drawings.

.5 Listing of alarm messages.

.6 Panel/circuit breaker number for sources of normal/emergency power.

.7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Departmental Representative.

.3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O M MANUALS

.1 Custom design O M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

.4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.

.5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at each OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:

.1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

.2 Detailed descriptions of program requirements and capabilities.

.3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.

.4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

.5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

.6 Software for each Controller and single section referencing Controller common parameters and functions.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

.2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Location: as directed by Departmental Representative.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment includingmotors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.

.2 ANSI C2-1990, National Electrical Safety Code.

.3 ANSI/NFPA 70-1990, National Electrical Code.

.2 CSA Group

.1 CSA C22.1-12,

.2 CAN/CSA-C22.3 No. 7-10, Underground Systems.

.3 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit.

.4 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.5 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.

.6 CAN/CSA-C22.3 No. 1-10, Overhead Systems.

1.2 SYSTEM DESCRIPTION

.1 Electrical:

.1 Provide power wiring from existing power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.

.2 Hard wiring between field control devices and EMCS field panels.

.3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.

.4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.2 Mechanical:

.1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 23.

.2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.

.3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.

.3 Structural:

.1 Special steelwork as required for installation of work.

1.3 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:

.1 Continuously direct and monitor all work.

.2 Attend site meetings.

1.4 EXISTING CONDITIONS

.1 Repair all surfaces damaged during execution of work.

.2 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

.1 Structural grade steel, primed and painted after construction and before installation.

2.2 WIRING

.1 As per requirements of Division 26.

.2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.

.3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.

.4 Sizes:

.1 120V Power supply: to match or exceed breaker, size #12 minimum.

.2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.

.3 Field wiring to digital device: 20 AWG stranded twisted pair or #18 AWG, and in accordance with manufacture's recommendation.

.4 Analog input and output: shielded #20 minimum stranded twisted pair or #18 minimum solid copper, and in accordance with manufacture's recommendation. Wiring must be continuous without joints.

.5 More than 4 conductors: #22 minimum solid copper.

.5 Terminations:

.1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.3 CONDUIT

.1 As per requirements of Division 26.

.2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.

.3 Junction and pull boxes: welded steel.

.1 Surface mounting cast FS: screw-on flat covers.

.2 Flush mounting: covers with 25 mm minimum extension all round.

.4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.

.5 Outlet boxes: 100 mm minimum, square.

.6 Conduit boxes, fittings:

.1 Bushings and connectors: with nylon insulated throats.

.2 With push pennies to prevent entry of foreign materials.

.7 Fittings for rigid conduit:

.1 Couplings and fittings: threaded type steel.

.2 Double locknuts and insulated bushings: use on sheet metal boxes.

.3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.

.8 Fittings for thin wall conduit:

.1 Connectors and couplings: steel, set screw type.

2.4 WIRING DEVICES, COVER PLATES

.1 Conform to CSA.

.2 Receptacles:

.1 Duplex: CSA type 5-15R.

.2 Single: CSA type 5-15R.

.3 Cover plates and blank plates: finish to match other plates in area.

2.5 STARTERS, CONTROL DEVICES

.1 Across-the-line magnetic starters:

.1 Enclosures: CSA Type 1, except where otherwise specified.

.2 Size, type and rating: to suit motors.

.2 Starter diagrams:

.1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.

.3 Auxiliary Control Devices:

.1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.

.2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.

.3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.

.4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

.4 Finish for starters:

.1 Exterior: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Interior: white.

2.6 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

.1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.

.1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.

.2 Exposed conduits or cables:

.1 50 mm diameter and smaller: one-hole steel straps.

.2 Larger than 50 mm diameter: two-hole steel straps.

.3 Suspended support systems:

.1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.

.2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.2 SUPPORTS

.1 Install special supports as required and as indicated.

3.3 ELECTRICAL GENERAL

.1 Do complete installation in accordance with requirements of:

.1 Division 26, this specification.

.2 CSA 22.1 Canadian Electrical Code.

.3 ANSI/NFPA 70.

.4 ANSI C2.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.

.4 Conform to manufacturer's recommendations for storage, handling and installation.

.5 Check factory connections and joints. Tighten where necessary to ensure continuity.

.6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

.8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

.9 Install conduits, and sleeves prior to pouring of concrete.

.10 Holes through exterior wall and roofs: flash and make weatherproof.

.11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.

.12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

.1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.

.2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.

.3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.

.4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.

.5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.

.6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.

.7 Limit conduit length between pull boxes to less than 30 m.

.8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.

.9 Fastenings and supports for conduits, cables, and equipment:

.1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.

.2 Provide adequate support for raceways and cables, sloped vertically to equipment.

.3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.

.10 Install polypropylene fish cord in empty conduits for future use.

.11 Where conduits become blocked, remove and replace blocked sections.

.12 Pass conduits through structural members only after receipt of Departmental Representative's written approval.

.13 Conduits may be run in flanged portion of structural steel.

.14 Group conduits wherever possible on suspended or surface channels.

.15 Pull boxes:

.1 Install in inconspicuous but accessible locations.

.2 Support boxes independently of connecting conduits.

.3 Fill boxes with paper or foam to prevent entry of construction material.

.4 Provide correct size of openings. Reducing washers not permitted.

.5 Mark location of pull boxes on record drawings.

.6 Identify AC power junction boxes, by panel and circuit breaker.

.16 Install terminal blocks or strips indicated in cabinets.

.17 Install bonding conductor for 120 volt and above in conduit.

3.5 WIRING

.1 Install multiple wiring in ducts simultaneously.

.2 Do not pull spliced wiring inside conduits or ducts.

.3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.

.4 Tests: use only qualified personnel. Demonstrate that:

.1 Circuits are continuous, free from shorts, unspecified grounds.

.2 Resistance to ground of all circuits is greater than 50 Megohms.

.5 Provide Departmental Representative with test results showing locations, circuits, results of tests.

.6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.

.7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.

.8 Do not allow wiring to come into direct physical contact with compression screw.

.9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 WIRING DEVICES, COVER PLATES

.1 Receptacles:

.1 Install vertically in gang type outlet box when more than one receptacle is required in one location.

.2 Cover plates:

.1 Install suitable common cover plate where wiring devices are grouped.

.2 Use flush type cover plates only on flush type outlet boxes.

3.7 STARTERS, CONTROL DEVICES

.1 Install and make power and control connections as indicated.

.2 Install correct over-current devices.

.3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.

.4 Performance Verification:

.1 Operate switches and controls to verify functioning.

.2 Perform start and stop sequences of contactors and relays.

.3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.8 GROUNDING

.1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.

.2 Install separate grounding conductors in conduit within building.

.3 Install ground wire in all PVC ducts and in tunnel conduit systems.

.4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.9 TESTS

.1 General:

.1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.

.2 Give 14 days written notice of intention to test.

.3 Conduct in presence of DCC Representative and authority having jurisdiction.

.4 Conceal work only after tests satisfactorily completed.

.5 Report results of tests to Departmental Representative in writing.

.6 Preliminary tests:

.1 Conduct as directed to verify compliance with specified requirements.

.2 Make needed changes, adjustments, replacements.

.3 Insulation resistance tests:

.1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.

.2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction Departmental Representative and authority having jurisdiction.

3.10 IDENTIFICATION

.1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

.2 Related Requirements

.1 Not used.

.3 References.

.1 Canadian Standards Association (CSA International).

.1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

.1 BC(s) - Building Controller(s).

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.

.3 Submit detailed inspection reports to Departmental Representative.

.4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:

.1 Point name and location.

.2 Device type and range.

.3 Measured value.

.4 System displayed value.

.5 Calibration detail

.6 Indication if adjustment required,

.7 Other action taken or recommended.

.5 Submit network analysis report showing results with detailed recommendations to correct problems found.

.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.

.1 Maintain records and logs of each maintenance task on site.

.2 Organize cumulative records for each major component and for entire EMCS chronologically.

.3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.

.7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "Record drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:

.1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.

.4 Service personnel to be on site ready to service EMCS within 12 hours after receiving request for service.

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:

.1 Serial number identifying component involved.

.2 Location, date and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.5 Provide system modifications in writing.

.1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

1.5 SERVICE CONTRACTS

.1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.

.2 Service Contracts to include:

.1 Annual verification of field points for operation and calibration.

.2 2 visits per year.

.3 2 responses to emergency calls during day, per year.

.4 2 responses to emergency calls during silent hours per year.

.5 Silent hours defined as 1630 to 0800 weekdays, as well as weekends and statutory holidays.

.6 Complete inventory of installed system.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.

.2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.

.2 Check each field input/output device in accordance with CSA Z204.

.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:

.1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.

.2 Check equipment cooling fans as required.

.3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.

.4 Review system performance with Operations Supervisor and Departmental Representative to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:

.1 Minor inspection.

.2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

.3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.

.4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.

.5 Provide mechanical adjustments, and necessary maintenance on printers.

.6 Run system software diagnostics as required.

.7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.

.1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).

.2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.

.1 IEEE Std 802.3™-, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.

.2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.

.4 Treasury Board Information Technology Standard (TBITS).

.1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Data communication network to link Operator Workstations and Master Control Units (MCU).

.1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.

.2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:

.1 EMCS-LAN.

.2 Network interface cards.

.3 Network management hardware and software.

.4 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

.1 EMCS Local Area Network (EMCS-LAN).

.1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.

.2 EMCS-LAN to: BACnet.

.3 Each EMCS-LAN to be capable of supporting at least 50 devices.

.4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.

.5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.

.6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.

.7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access.

.1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.

.2 Access to data to be based upon logical identification of building equipment.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

.2 Secondary OWS: serves as backup to primary OWS, is storage and retrieval facility of soft copy of as-built contractor supplied data as described in Section 25 05 03 - EMCS: Project Record Documents.

.3 Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.

.4 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

1.3 OWS SYSTEM DESCRIPTION

.1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.

.2 Primary OWS to include:

.1 Colour graphics printer.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.5 ENVIRONMENTAL CONDITIONS

.1 OWS to operate in conditions of 10 degrees C to 32 degrees C and 20% to 90% non-condensing RH.

1.6 MAINTENANCE

.1 Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

Part 2 Products

2.1 OWS HARDWARE

.1 PC system to include:

.1 Processor: Pentium IV micro-processor, operating at minimum clock speed of 2 Gigahertz, capable of supporting software necessary to perform functions specified in this section. System backplane bus (200 Megahertz) to support PCI and ISA boards.

.2 Internal clock.

.1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.

.2 Rechargeable batteries: to provide minimum 48 h clock operation in event of power failure.

.3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.

.2 Power supply unit to accept 120 V, 60 Hz source and include line surge and low voltage protection for processor and its peripherals.

.3 Include UPS to provide 5 minutes minimum operation of PC, CRT and communication and peripheral devices; applies to fixed (non portable) OWS's and peripherals.

2.2 OWS PC COMPONENTS

.1 Primary OWS: IBM PC compatible with following as minimum:

.1 IDE Disk drive controller to support 4 drives.

.1 1 250 GB hard disk drive, 12 ms.

.2 1 48X/24X/48X CD-RW drive.

.2 4 GB RAM minimum.

.3 Enhanced 101 key keyboard.

.4 PS2 mouse.

.5 Colour monitor: 17". Flat panel display TFT, resolution 1280 X 1040, dot pitch 0.26 mm, colour support 24 bit,

.6 Video card with 32 MB video RAM.

.7 4 USB ports or 2 serial ports.

.8 Include two (2) spare expansion slots in system for the Departmental Representative's use.

.9 PCI Ethernet LAN Adapter to connect to local Ethernet LAN network.

.10 200 W minimum power supply.

2.3 PRINTERS

.1 Colour graphics printer include following features:

.1 Ink-jet technology capable of printing high quality colour images at speed of 4 pages per minute.

.2 Black cartridge to be separate cartridge from red green blue cartridge.

.3 Minimum colour resolution 2400 by 1200 dpi.

.4 Minimum black and white resolution 1200 by 1200 dpi.

.5 Minimum 8 MB RAM.

.2 Include one box of 8.5 X 11" and one box of 8.5 X 14" paper.

2.4 OPERATING SYSTEM (OS) OR EXECUTIVE

.1 OS to support complement of hardware terminals and software programs specified.

.2 OS to be true multitasking operating environment.

.1 MS DOS or PC DOS based software platforms not permitted.

.3 OWS software to operate in "Windows" based operating environment: Windows 7, 10 or Unix "X' Windows based system.

2.5 OWS CONTROL SOFTWARE

.1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.

.2 Time Synchronization Module.

.1 System to provide Time Synchronization of real-time clocks in controllers.

.2 System to perform this feature on regular scheduled basis and on operator request.

.3 User Display Interface Module.

.1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.

.2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.

.4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:

.1 Operator Log-in from user interface device.

.2 Communication messages: errors, failures and recovery.

.3 Event notifications and alarms by category.

.4 Record of operator initiated commands.

.5 General Event Log:

.1 Hold minimum of 4 months information and be readily accessible to operator.

.2 Able to be archived as necessary to prevent loss of information.

.6 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:

.1 Automatic logging of digital alarms and change of status messages.

.2 Automatic logging of analog alarms.

.3 System changes: alarm limits, set-points, alarm lockouts.

.4 Display specific point values, states as selected.

.5 Provide reports as requested and on scheduled basis when required.

.6 Display graphics as requested, and on alarm receptions (user's option).

.7 Display list of points within system.

.8 Display list of systems within building.

.9 Direct output of information to selected peripheral device.

.10 On-line changes:

.1 Alarm limits.

.2 Setpoints.

.3 Deadbands.

.4 Control and change of state changes.

.5 Time, day, month, year.

.6 Control loop configuration changes for controller-based CDLs.

.7 Control loop tuning changes.

.8 Schedule changes.

.9 Changes, additions, or deletions, of points, graphics, for installed and future systems.

.11 According to assigned user privileges (password definition) following functions are to be supported:

.1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.

.2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.

.12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.

.7 Message Handling Module - and Error Messages: to provide message handling for following conditions:

.1 Message and alarm buffering to prevent loss of information.

.2 Error detection correction and retransmission to guarantee data integrity.

.3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.

.4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.

.8 Access ControlModule.

.1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:

.1 Guest: no password data access and display only.

.2 Operator Level: full operational commands including automatic override.

.3 Technician: data base modifications.

.4 Programmer: data base generation.

.5 Highest Level: system administration - password assignment addition, modification.

.2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.

.9 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.

.1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate from 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.

.2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 h basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.

.3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.

.4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.

.5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.

.10 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01 - EMCS: Building Controllers.

.1 Reports to include time, day, month, year, report title, operator's initials.

.2 Software to provide capability to:

.1 Generate and format reports for graphical and numerical display from real time and stored data.

.2 Print and store reports as selected by operator.

.3 Select and assign points used in such reports.

.4 Sort output by area, system, as minimum.

.3 Periodic/automatic report:

.1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.

.2 Reports to include:

.1 Power demand and duty cycle summary: see application program for same.

.2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.

.3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.

.4 Summary of run time alarms: include point name, run time to date, alarm limit.

.5 Summary of start/stop schedules: include start/stop times and days, point name.

.6 Motor status summary.

.4 Report types:

.1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:

.2 Points in accessible from this OWS (total connected for this location), multiple "areas".

.3 Area (points and systems in Area).

.4 Area, system (points in system).

.5 System (points by system type).

.6 System point (points by system and point object type).

.7 Area point (points by system and point object type).

.8 Point (points by point object type).

.5 Summary report: printout or display of point objet data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.

.6 Include preformatted reports as listed in Event/Alarm Module.

.11 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

.1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlayed with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.

.2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.

.3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.

.4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:

.1 Modify portion of graphic picture/schematic background.

.2 Delete graphic picture.

.3 Call up and cancel display of graphic picture.

.4 Define symbols.

.5 Position and size symbols.

.6 Define background screens.

.7 Define connecting lines, curves.

.8 Locate, orient, size descriptive text.

.9 Define, display colours of elements.

.10 Establish co-relation between symbols or text and associated system points or other graphic displays.

.5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.

.6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.

.7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2 OWS's.

.8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Departmental Representative. In addition provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and , flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Departmental Representative to provide CAD floor layouts. Provide display of TCU -VAV's in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.

.9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click” to activate selected graphic.

.10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain English and French language.

.12 Event/Alarm Module : displays in window alarms as received and stored in General Event Log.

.1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.

.2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.

.3 Alarm reports.

.1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.

.2 Analog alarm limit summary: include point name, alarm limits, deviation limits.

.3 Summary of alarm messages: include associated point name, alarm description.

.4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.

.5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:

.1 Critical – 5 seconds.

.2 Cautionary – 10 seconds.

.3 Maintenance – 10 seconds.

.6 Display alarm messages in English and French.

.7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.

.8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgment of one alarm as acknowledgement of other alarms.

.9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:

.1 Controller not responding - where possible delineate between controller and communication line failure.

.2 Controller responding - return to normal.

.3 Controller communications bad - high error rate or loss of communication.

.4 Controller communications normal - return to normal.

.10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.

.13 Archiving and Restoration Module.

.1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.

.2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.

.3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.

.14 CDL Generator and Modifier Module.

.1 CDL Generator module to permit generation and modification of CDLs.

.2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.

.3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.

.4 Module to permit testing of code before downloading to building controllers.

2.6 ADDITIONAL UTILITY SOFTWARE

.1 Supply and install on primary OWS, following software utilities and include:

.1 Full-featured PDF reader with annotation and editing capabilities.

.2 Include special drivers, fonts, to ensure complete and proper functioning of software packages specified. Deliver system complete with full set of User Manuals.

.3 Enter soft copy submissions, including "Record" drawings specified in Section 25 05 03 - EMCS: Project Record Documents in OWS.

.4 Enter soft copy of Architectural, Electrical, Mechanical systems plans and "Record" drawings in OWS. Plans and drawings to be provided by Departmental Representative.

Part 3 Execution

3.1 INSTALLATION REQUIREMENTS

.1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.

.1 Install tamper locks on breakers of circuit panels.

.2 Refer to UPS requirements stated under OWS Hardware in PART 2.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).

.2 Local Control Unit (LCU).

.3 Equipment Control Unit (ECU).

.4 Terminal Control Unit (TCU).

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).

.1 C22.2 No.205-M1983(R1999), Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

1.5 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA;

.2 0 - 10 V DC;

.3 100/1000 ohm RTD input;

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.3 Mounting details as approved by Departmental Representative for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.1 MCU must support BACnet.

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.

.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).

.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.

.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.3 VAV Terminal Controller.

.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.

.2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.

.3 Controller to operate independent of network in case of communication failure.

.4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start stop.

.6 Night setback control.

.7 Enthalpy (economizer) switchover.

.8 Peak demand limiting.

.9 Temperature compensated load rolling.

.10 Fan speed/flow rate control.

.11 Cold deck reset.

.12 Hot deck reset.

.13 Hot water reset.

.14 Chilled water reset.

.15 Condenser water reset.

.16 Chiller sequencing.

.17 Night purge.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.

.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.

.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.

.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.

.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWH, litres, tonnes, etc.).

.6 Store event totalization records with minimum of 9,999,999 events before reset.

.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.

.1 Display analog values digitally to 1 place of decimals with negative sign as required.

.2 Update displayed analog values and status when new values received.

.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.

.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support Departmental Representative point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as indicated or as directed by Departmental Representative.

.2 Provide necessary power from local 120V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23 - EMCS General Requirements and other related EMCS Sections.

.2 The letters under the "Type" column in the following Schedule are the same used in Section 23 09 30 “Point Database Schedule” and also on the drawings.

Part 2 Products

2.1 SENSING DEVICES

.1 Provide field instrumentation and sensing devices, analog or digital as applicable, which measure temperature, humidity, pressure, flow, current, voltage, equipment states, etc. and which input signals to the RCU or TCU terminal strip that conform to the input requirements specified in Sections 23 09 26 and 23 09 27, "Signal Processing" articles.

.2 The end-to-end accuracy called for in the following Schedule includes the combined effect of all the errors in all the interposing devices and components between the measured variable and the value displayed at the Central Control Station.

.3 For all sensors in piping, provide stainless steel wells and all required adaptors. Provide **rigid metal** nipples between well and sensor junction box. For retrofit projects, existing wells may be reused if they are no longer required for any other purpose, are in good condition and are compatible with the new sensors.

2.2 ACTUATORS

.1 Provide output devices, motors and actuators which convert the digital or analog output signal from the RCU or TCU to activate relays or open and close valves, dampers, etc., that conform to the output requirements specified in Sections 23 09 26 and 23 09 27 “Signal Processing” articles.

.2 The end-to-end accuracy called for in the following Schedule includes the combined effect of all the errors in all the interposing devices and components between the value entered at the Central Control Station and the position of the final control element. In retrofit situations, where the final control elements or actuators are allowed to be reused, end-to-end accuracy refers only to the signal sent to the final control element or actuator.

.3 Actuators shall be gear driven with spring return to "fail safe" in normally closed position as dictated by freeze, fire or temperature protection. Actuator shall include a manual override allowing end device to be positioned and locked into place should the actuator fail.

.4 For dampers provide actuator motor with 0.56 Nm per 0.929 m2 of damper area.

.5 Standard of quality: Belimo

2.3 CONTROL VALVES

.1 Provide valves in accordance with general valve specification. Provide position indicators on valves.

.2 Valves shall "fail safe" in normally open or closed position as dictated by freeze, humidity, fire or temperature protection as follows or as specified in Sections 23 09 30 “Point Database Schedule or 23 09 93 EMCS Control Sequences.

.3	Zone Perimeter Heat Valves	N.O.
.4	Force Flows & Unit Heaters Valve	N.O.
.5	Fan Coil Heating Valve	N.O.
.6	Fan Coil Cooling Valve	N.C.
.7	Air System Heating Valve	N.O.
.8	Air System Cooling Valve	N.O.
.9	Air System Humidifier Valve	N.C.
.10	Differential Pressure Control Valve	N.C.
.11	Main Heating System Valves	N.O.

.12 Two-way valves for liquids shall have equal percentage characteristics. Three way valves shall have linear characteristics. Size valve operators to close valves against pump shut off head.

.13 Steam valves shall have modified linear characteristics with stainless steel seats. Provide separate valves on individual coils. Two valves in parallel shall have 1/3 - 2/3 load capacities sequenced so that smaller valve opens first. The larger valve shall start opening just before the small valve’s fully open position.

2.4 DAMPERS

.1 Provide low leakage type dampers with hollow blades filled with extruded polyurethane insulation for outside air or exhaust air dampers. Damper assembly shall have a thermal insulation value of R 0.35 oC m2/W Tamco 9000 or equal.

.2 Blades shall be minimum 2.75 mm extruded aluminium. Blades shall be of air foil design, 150 mm wide. Maximum blade length 1200 mm.

.3 Damper seals shall be designed for minimum air leakage by means of overlapping seals.

.4 Frames shall be minimum 2.75 mm extruded aluminium channel with grooved inserts for seal.

.5 Install blade linkage hardware in frame out of air stream.

.6 Arrange linkage and provide an adequate number of damper operators to ensure that the interconnected damper sections operate in unison without binding.

.7 Damper operators shall be supplied by controls contractor and installed by the Air Processing Unit manufacturer at the factory, in accordance with instructions from controls contractor. Extend drive and provide mounting bracket to place outdoor air actuators outside air stream. Check unit and room height to ensure adequate space if extended through top of cabinet.

2.5 ANALOG INPUT SENSORS – TEMPERATURE

Application	Type	Operating Range	End to End Accuracy	Remarks
Duct Probe	Tp	0°C to 60°C	±0.3°C	Length to suit duct size.
Pipe Well	Tw	0°C to 50°C 0°C to 100°C 50°C to 150°C	±0.3°C ±0.5°C ±0.5°C	C/w stainless wells, range to suit application c/w rigid metal nipples and metal junction box
Averaging	Ta	-30°C to 50°C	±0.5°C	C/w supporting wire and brackets. Sensors to be covered with copper sheathing.
Room/Space	Tr	10°C to 30°C	±0.3°C	C/w tamper proof cover.
Outside Air	To	-50°C to 50°C	±0.5°C	C/w solar shield.
Surface	Ts	0°C to 50°C 0°C to 100°C 50°C to 150°C	±0.3°C ±0.5°C ±0.5°C	C/w anchor strap.

2.6 ANALOG INPUT SENSORS - RELATIVE HUMIDITY

Application	Type	Operating Range	End to End Accuracy	Remarks
Duct Probe	Hp	5 to 90% RH 0°C to 60°C	±3%	Must be usable over 0 to 100% RH range
Room/Space	Hr	10 to 90% RH 10°C to 30°C	±3%	C/w tamper proof cover.
Outside Air	Ho	5 to 90% RH- 50°C to 50°C	±5%	C/w solar shield. Must be usable over 0 to 100% RH range

2.7 ANALOG INPUT SENSORS – PRESSURE

Application	Type	Operating Range	End to End Accuracy	Remarks
Static	Ps	as required: 25 - 50% greater than max design	±2% full scale	Materials to suit medium in contact with device
Differential	Pd	as required: 25 - 50% greater than max design	±2% full scale	Materials to suit medium in contact with device.
Velocity Pressure	Pv	as required: 25 - 40% greater than max design or max measured velocity pressure at full flow rate.	±1.0% full scale	Air: Multi-point static & total pressure sensing element, self- averaging manifold, air equalizer and straightener, max pressure loss 36 Pa @ 10 m/sec. Water & Steam: Annubar or orifice plate.

2.8 ANALOG INPUT SENSORS – ELECTRIC

Application	Type	Operating Range	End to End Accuracy	Remarks
Watt Meter	Kw	as required	±0.25% Full scale	3 current transformers 2 potential transformers as applicable for “Y” or “D” configuration.
Current Transformer	Kw	as required:	±0.25% full scale	
Current Transducers	Ct	as required:	±0.25% full scale	4 to 20 mA DC or 0 to 10 VDC.

2.9 ANALOG INPUT SENSORS – MISCELLANEOUS

Application	Type	Operating Range	End to End Accuracy	Remarks
Carbon Monoxide	Co	0 to 200 PPM	±5% Full range	Electrochemical devices ONLY Device must not be sensitive to ambient air temp or relative humidity.
Turbine Water Flow Meter	Fw	175:1 turn down from 0.052 to 9.14 m/s	±5% Full range	Onicon F-1100 or F-1200 series as required to meet minimum straight pipe requirements.
BTU Meter	BTU	Flow sensor 175:1 turn down from 0.052 to 9.14 m/s	±5% Full range	Onicon System-10 complete with flow and temperature sensors. Available with LONWORK, MODBUS, JCI N-

		Temperature sensors 0-93.3°C	±0.08°C	2, Siemens P-1 and BACnet network cards.
Thermal Dispersion Airflow Measurement	Fag	0 to 25.4 m/s	± 2% of reading	Ebtron Gtx116-P series # of sensors as required to meet C density at minimum straight duct requirements.
Thermal Dispersion Airflow Measurement	Fah	0 to 25.4 m/s	± 2% of reading	Ebtron HTx104-P series # of sensors as required to meet C density at minimum straight duct requirements.
Thermal Dispersion Airflow Measurement	Fas	0 to 25.4 m/s	± 2% of reading	Ebtron STx102 series # of sensors as required to meet C density at minimum straight duct requirements.
Thermal Dispersion Airflow Measurement	Fae	0 to 25.4 m/s	± 2% of reading	Ebtron ELF series.

2.10 ANALOG OUTPUT DEVICES – ELECTRIC

Application	Type	Operating Range	End to End Accuracy	Remarks
To Damper Motors	Dm	4 to 20 mA DC 0 to 10 VDC 0 to 5 VDC	±2% Full Range	Match range if existing
To Valve Motors	Vm	4 to 20 mA DC 0 to 10 VDC 0 to 5 VDC	±2% Full Range	
To Equipment Supplied By Others	Vo	4 to 20 mA DC 0 to 10 VDC 0 to 5 VDC	±2% Full Range	

SPEC NOTE: Only use following clause when pneumatic actuators are being reused for retrofit contracts.

2.11 ANALOG OUTPUT DEVICES – PNEUMATIC

Application	Type	Operating Range	End to End Accuracy	Remarks
To Damper Actuators	Da	20 - 104 kPa	±2% Full Range	I/P transducer, provide output pressure gauge.
To Valve Actuators	Va	20 - 104 kPa	±2% Full Range	I/P transducer, provide output pressure gauge.

2.12 DIGITAL INPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
Dry Contact	Dc	N/A	N/A	
End Switch	Esw	N/A	N/A	Adjustable position.
Level Switch	Lsw	N/A	N/A	Adjustable setpoint and differential. Pressure rating suitable to application.
Pressure Switch	Psw	as required	±1.5% Full Scale	Adjustable setpoint and differential.
Temperature Switch	Tsw	as required	±1°C	Adjustable setpoint and differential. Manual reset for freeze protection.
Current Sensitive Relay	Ri	as required	N/A	Adjustable trip setpoint and Differential.
P/E Relay	Pe	0 – 120 kPa	N/A	Adjustable setpoint and differential.

2.13 DIGITAL OUTPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
Relays	Ry	N/A	N/A	DPDT, plug-in type terminal base. Contacts rated to suit motor starter.
E/P Relays	Ep	N/A	N/A	

Part 3 Execution

3.1 INSTALLATION

.1 All transducers and devices are to be mounted in equipment cabinets with hinged doors. Unless specifically approved in writing, equipment cabinets shall be installed near RCU cabinets, at eye level, in easily accessible areas, on solid walls or supported away from vibrating equipment. Cabinets not in mechanical rooms shall have lockable doors keyed the same as RCU cabinets.

.2 For all sensors in piping, confirm locations of wells and availability of any existing wells where applicable. Use thermal conductive compound when installing sensors to ensure proper thermal coupling of sensor to well. No more than 2 meters of flex shall be used between sensor housing and raceway. Flex to be secured within 1 meter of sensor.

.3 Install a pressure gauge on the signal line of each electro-pneumatic transducer (EPT) or pneumatic controller, excepting room temperature controllers.

.4 Install a brass tee in the high and low side lines of every air flow station and differential pressure transducer, excepting those on room VAV box controls. Cap off open end of tee with 10 cm stub and plug or brass coupling and rubber cap Tees to be located close to device in such a manner as to allow for easy access during commissioning procedures.

.5 Coordinate with mechanical contractor to ensure flow stations supplier minimum straight duct requirements are maintained.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Read this section in conjunction with Sections 23 09 23 - Energy Management and Control Systems (EMCS) General Requirements, 23 08 95 EMCS Start-up and Testing and other related EMCS Sections.

1.2 REFERENCES

.1 Public Works and Government Services Canada (PWGSC)/ Real Property Branch/Architectural and Engineering Services

.1 MD13800 Energy Management and Control Systems (EMCS) Design Manual

Part 2 Products

.1 Not used

Part 3 Execution

3.1 GENERAL REQUIREMENTS

.1 Provide the database for all physical points listed in the Point Schedule.

.2 Provide the database for all virtual points identified in this section. Provide all necessary controllers, display screens, trend logs as well as any other item as may be required to create, test and modify the control strategies.

.3 Provide all programming required to implement the control sequences described in this section.

.4 Programming style is to be of a form that enables the control strategies to be easily followed. Clarity, simplicity and elegance are more important than program size.

.5 All programs must include a sufficient number of comments to allow another person to make changes to the strategies at some later time.

.6 Additional programming may be provided by the Contractor as desired, so long as it does not affect the intended operation of the specified sequences. Ensure that all equipment will operate in a safe manner.

.7 Programming required for equipment safety may be installed by the Contractor as necessary. The Owner shall be notified of these changes as soon as practical.

.8 All deviations from the specified programming, except those related to equipment safety, must receive prior written approval from the Owner.

.9 All control loops shall be tuned such that they are stable through all seasons and operating conditions including startup.

.10 During the construction period through to the end of the warranty period, the Contractor shall be responsible for fine tuning the controls programming to ensure satisfactory operation. During this period the Contractor will also be responsible for any minor revisions requested by the Owner.

3.2 SEQUENCING

.1 Present sequencing of operations for system, in accordance with MD13800 – Energy Management and control System (EMCS) Design Manual.

3.3 MISCELLANEOUS REQUIREMENTS

.1 Staggered starting - Motors must not be allowed to start at the same time. Under all conditions of startup, return from power failure or panel reset, there must be at least a 15 second delay between the time one motor starts and another is allowed to start.

.2 Ensure air handling system plenums are maintained above freezing at all times, either by overriding a heating coil or by periodically operating the return fan with dampers closed to outside air. In air systems containing water coils, or where downstream reheat coils can be affected by cold supply air, provide a dial-out-alarm should the supply temperature be below 3 degC for longer than 30 minutes.

3.4 BUILDING OPERATING MODES

.1 Three operating modes are required: Purge, Occupied and Unoccupied.

.2 An optimum start routine shall be used to determine when the air systems are to begin operation such that adequate comfort conditions are reached just before occupancy begins.

.3 Occupied Mode:

.1 The beginning and ending time of this mode shall be determined by a weekly schedule. An annual holiday schedule shall be used to bypass statutory holidays.

.2 One weekly/annual schedule is required.

.3 During this mode all spaces within the building are to be at occupied comfort conditions. Air systems are to be running. Heating and cooling are to be used as required.

.4 The optimum start routine enables the occupied mode prior to scheduled occupancy. This allows the air systems to condition the spaces such that they are comfortable at the time of scheduled occupancy. The minimum outside air shall be set to 0 l/s during the optimum start time period.

.4 Purge Mode:

.1 This mode is used to purge the spaces with cool morning air on warm days.

.2 Purge is allowed to start as soon as 3 hours before normal occupancy and is stopped as soon as the occupied mode starts or the time is later than 9:00 am. Once started it shall not stop until at least 30 minutes have elapsed or occupied mode has begun.

.3 This mode is allowed only if the outside air temperature is above 8degC and is at least 5 degC lower than the average space temperature.

.4 During this mode no mechanical cooling or heating shall be allowed.

.5 Purging shall be optimized such that it is only active long enough to bring space temperatures well into the comfort range. A reasonable initial estimate of this time in hours is:

(Rta - 22.5) / (RTa - (OAT + 2)) * 8
where Rta = average room temperature
OAT = outside air temperature

3.5 GLOBAL PROGRAMS

.1 Define a space temperature objective value STOBJ. Program it with a default value of 22.5 degC such that the value returns to 22.5 if the point is not manually commanded to some other value.

.2 Define a space temperature objective user adjust value STOBJ_UA (limited - 2 to +2 degC). Program it with a default value of zero degC such that the value returns to zero if the point is not manually commanded to some other value.

.3 Obtain some basic information from the room temperature sensors:

.1 STMAX warmest space temperature

.2 STAVG average of the two sensors

.3 STMIN coolest space temperature

.4 Define an effective space temperature ***STEFF***, for the building as follows:

.1 If the outside air temperature OAT is less than 5 degC then STEFF is the average of STMIN and STAVG.

.2 If OAT is greater than 20 degC then STEFF is the average of STMAX and STAVG.

.3 Otherwise STEFF equals STAVG.

.4 Smooth STEFF so that it cannot change faster than about 1 degC per hour.

.5 Provide an outside air temperature prediction routine which provides the following data:

.1 ***OAPHT*** predicted high temperature

.2 ***OAPLT*** predicted low temperature

.3 ***OADH*** day's high temperature

.4 ***OAHDH*** hour that day's high occurred

.5 ***OADL*** day's low temperature

.6 ***OAHDL*** hour that day's low occurred

.7 ***OAYTD*** yesterday's temperature difference

.8 ***OAODH*** old (previous) day's high ***temperature***

.9 ***OAODL*** old (previous) day's low temperature

3.6 VERIFICATION OF CUSTOM CONTROL SOFTWARE

.1 Provide copies of trend logs that clearly indicate the:

.1 stability of each control loop under various load conditions including modest step setpoint changes.

.2 adequacy of system startup during summer and winter conditions.

.3 proper operation of the outside air temperature prediction routines.

.4 adequacy of space comfort conditions.

3.7 CONTROL SEQUENCES

.1 Heating Water System

.1 The heating system consists of two boilers B-1 and B-2, each sized for 100% of the total heating load and two boiler circulation pumps P-1 & P-2.

.2 The boilers have been specified to have integral staging control, firing rate controls, boiler circulation pump control and BACnet cards. Provide a BACnet connection to each boiler and allow for mapping of 8 points per pump to the EMCS graphics.

.3 The ECMS shall provide boiler supply temperature reset.

.4 Provide all safety or operational interlocks to boiler control panels as required. Boiler low water cutoff switch, flow switch and temperature limit switches to be supplied by the boiler supplier.

.5 The boilers shall alternate lead/lag monthly (adjustable). All boilers and heating circulation pumps shall be overridden by an annual schedule and outside air temperature. Schedule shall be initially set to disable all boilers between June 1st and September 30th (adjustable). If the outside air temperature is less than 15°C and lowest room temperature sensor is more than 1°C below set point, the lead boiler shall be enabled. If the outside air temperature is less that 5°C (adjustable), the lead boiler shall always be enabled. The boiler supply water temperature setpoint shall be adjusted according to the outdoor air reset schedule and also be reset plus or minus 5°C (adjustable) according to average space heating demand.

.6 A heating system pressure sensor will monitor the heating water system pressure. Provide alarms if the pressure increases above 235 kPa or decreases below 35 kPa.

.7 Provide alarms for boiler ignition failure, low heating water temperature and pump failure. Disable heating alarms when outside air temperature is above the heating system shutdown setpoint.

.8 The setpoint of the heating loop shall be provided by the EMCS system. The supply temperature to building heating loop is reset as follows:

O/A Temp.	HWS
-28°C or less	82.2°C

15°C or higher	70.0°C

.9 The boiler supply water temperature setpoint shall be reset plus or minus 5°C (adjustable) according to average space heating demand.

.10 Provide an emergency disable red mushroom type latching push button at the exit of the boiler room and wire the dedicated switch contacts in series with the boiler safeties. Provide a dedicated contact for BMS monitoring and alarming.

.2 Trades Compound Secondary Heating Loop

.1 The Trades Compound secondary heating systems consists of two secondary heating water circulation pumps P-3 & P-4 each sized for 100% of the total heating load.

.2 The pumps shall operate on a Lead/Lag bases. The lead pump shall operate whenever the boiler system is enabled.

.3 The pumps have been specified to have integral variable frequency drives (VFD) complete with BACnet cards. Provide a BACnet connection to each pump controller and allow for mapping of 8 points per pump to the EMCS graphics.

.4 The lead secondary circulation pump speed shall be modulated to maintain the differential pressure setpoint as measured by a differential pressure sensor located on the supply and return lines at the end of the line. When the lead pump speed rises to 100% and the differential pressure setpoint is not being maintain for 5 minutes, the lag pump shall be enabled and it’s speed modulated in unisons with the lead pump. When both pump speeds fall below 45% for 5 minutes, the lag pump shall be disabled.

.5 On the failure of the lead secondary pump, an alarm shall be generated at the BMS graphics and the lead pump shall be alternated.

.6 When the lead pump is alternated bases on run time, the new lead pump status will prove before the old lead pump is disabled.

.7 On system startup, the lead pump speed shall be overridden to limit the return water temperature to the boilers to a minimum temperature of 50°C.

.3 Warden Compound Secondary Heating Loop

.1 The Trades Compound secondary heating systems consists of two secondary heating water circulation pumps P-5 & P-6 each sized for 100% of the total heating load.

.2 The pumps shall operate on a Lead/Lag bases. The lead pump shall operate whenever the boiler system is enabled.

.3 The pumps have been specified to have integral variable frequency drives (VFD) complete with BACnet cards. Provide a BACnet connection to each

pump controller and allow for mapping of 8 points per pump to the EMCS graphics.

.4 The lead secondary circulation pump speed shall be modulated to maintain the differential pressure setpoint as measured by a differential pressure sensor located on the supply and return lines at the end of the line. When the lead pump speed rises to 100% and the differential pressure setpoint is not being maintain for 5 minutes, the lag pump shall be enabled and it's speed modulated in unisons with the lead pump. When both pump speeds fall below 45% for 5 minutes, the lag pump shall be disabled.

.5 On the failure of the lead secondary pump, an alarm shall be generated at the BMS graphics and the lead pump shall be alternated.

.6 When the lead pump is alternated bases on run time, the new lead pump status will prove before the old lead pump is disabled.

.7 On system startup, the lead pump speed shall be overridden to limit the return water temperature to the boilers to a minimum temperature of 50°C.

.4 Domestic Hot Water System

.1 The on board controls for domestic water heater maintain the water supply temperature setpoint. EMCS sensor monitors the domestic supply water temperature, an alarm is generated if the temperature is above or below alarm limits.

.2 The EMCS controls the re-circulation pump, the pump shall operate when any one of the AHUs is operating in the occupied mode or in optimal start mode. An alarm is generated on pump failure.

.5 South Offices Air Handling Unit AHU-1

.1 Air handling unit AHU-1 is a constant volume, mixed air unit providing ventilation air to the south offices.

.2 The exhaust for washroom, janitor room and lunch room are ducted to exhaust fans EF-3, EF-4 and EF-8 respectively. Provide motorized dampers for EF-3 and EF-8 and hardwire the dampers so that on a start command from the BMS, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts. EF-4 is not controlled or monitored by the BMS.

.3 Heating for the individual zones is provided by radiant panels or reheat coils located in each zone.

.4 AHU-1 consists of an outside air damper, a return air damper, a filter section, a supply fan, an indirect gas heater section, a return fan and a BACnet controller.

.5 Provide a BACnet connection to the unit controller and allow for mapping of points to the unit graphics. Refer to points list for mapped points.

.6 System Start/Stop

.1 AHU-1 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 When both the supply fan and return fan are operating, EF-3 shall be started and AHU-1's minimum outside air percentage shall be adjusted, via the BACnet connection, to allow for building pressurization based on the total exhaust volume.

.3 EF-8 shall be manually started based on a crank timer located in the lunch room.

.4 EF-4 shall operate continuously.

.5 On a failure of either fan, the system shall be disabled and an alarm shall be sent to the EMCS graphics.

.7 Temperature Control

.1 The unit supplied controls shall control the mixed air dampers and gas heater to maintain the supply air temperature setpoint initially set at 13°C.

.8 Alarms

.1 The BMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.9 Occupant Override

.1 Provide manual override through room space sensors to energize AHU-1 during unoccupied mode. Activation of unit during unoccupied mode shall energize the unit for a period of 60 minutes (adjustable).

.2 Provide an override of this feature on the unit graphics.

.6 West Offices Air Handling Unit AHU-2

.1 Air handling unit AHU-2 is a constant volume, mixed air unit providing ventilation air to the west offices.

.2 The exhaust for lunch room and washrooms are ducted to exhaust fans EF-6 and EF-7 respectively. Provide motorized damper for EF-6 and EF-7 and hardwire the dampers so that on a start command from the BMS, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts.

.3 Heating for the individual zone is provided by radiant panels or reheat coils located in each zone.

.4 AHU-2 consists of an outside air damper, a return air damper, a filter section, a supply fan, an indirect gas heater section, a return fan and a BACnet controller.

.5 Provide a BACnet connection to the unit controller and allow for mapping of points to the unit graphics. Refer to points list for mapped points.

.6 System Start/Stop

.1 AHU-2 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 When both the supply fan and return fan are operating, EF-7 shall be started and AHU-2's minimum outside air percentage shall be adjusted, via the BACnet connection, to allow for building pressurization based on the total exhaust volume.

.3 EF-6 shall be manually started based on a crank timer located in the lunch room.

.4 On a failure of either fan, the system shall be disabled and an alarm shall be sent to the EMCS graphics.

.7 Temperature Control

.1 The unit supplied controls shall control the mixed air dampers and gas heater to maintain the supply air temperature setpoint initially set at 13°C.

.8 Alarms

.1 The BMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.9 Occupant Override

.1 Provide manual override through room space sensors to energize AHU-2 during unoccupied mode. Activation of unit during unoccupied mode shall energize the unit for a period of 60 minutes (adjustable).

.2 Provide an override of this feature on the unit graphics.

.7 Storage Offices Air Handling Unit AHU-3

.1 Air handling unit AHU-3 is a constant volume, mixed air unit providing ventilation air and heating to the west offices.

.2 The exhaust for the change rooms and washrooms are ducted to exhaust fan EF-21 and EF-22 respectively. Provide motorized damper for EF-21 and EF-22 and hardwire the dampers so that on a start command from the BMS, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts.

.3 AHU-3 consists of an outside air damper, a return air damper, a filter section, a supply fan, an indirect gas heater section, a return fan and a BACnet controller.

.4 Provide a BACnet connection to the unit controller and allow for mapping of points to the unit graphics. Refer to points list for mapped points.

.5 System Start/Stop

.1 AHU-3 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 When both the supply fan and return fan are operating, EF-21 and EF-22 shall be started and AHU-3's minimum outside air percentage shall be adjusted, via the BACnet connection, to allow for building pressurization based on the total exhaust volume.

.3 On a failure of either fan, the system shall be disabled and an alarm shall be sent to the EMCS graphics.

.6 Temperature Control

.1 The unit supplied controls shall control the mixed air dampers and gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be reset by the outside air temperature.

.7 Alarms

.1 The BMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.8 Occupant Override

.1 Provide manual override through room space sensors to energize AHU-3 during unoccupied mode. Activation of unit during unoccupied mode shall energize the unit for a period of 60 minutes (adjustable).

.2 Provide an override of this feature on the unit graphics.

.8 Basement Locker Room Makeup Air Unit MUA-1

.1 Makeup air unit MUA-1 is a constant volume, 100% outside air system providing makeup air to the basement.

.2 Heating for the individual zone is provided by radiation located in each zone.

.3 The exhaust for the basement is ducted to exhaust fan EF-1. Provide a motorized damper for EF-1 and hardwire the damper so that on a start command from the BMS, the damper opens. Once the damper end-switch proves that the damper is open, the fan starts.

.4 MUA-1 consists of an outside air damper, a filter section, an indirect gas heating section a supply fan and a BACnet controller.

.5 System Start/Stop

.1 MUA-1 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 On system startup, the supply fan and exhaust fan EF-1 shall be energized.

.3 Should either fan fail, the system shall be disabled and an alarm shall be generated on the graphics.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be reset by the average space heating demand.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.7 Alarms

1. The ECMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.9 Level 1 Warehouse Makeup Air Unit MUA-2

.1 Makeup air unit MUA-2 is a constant volume, 100% outside air system providing makeup air to the level 1 warehouse.

.2 Heating for the individual zone is provided by gas unit heaters located in each zone.

.3 The exhaust for the warehouse is ducted to exhaust fan EF-2. Provide a motorized damper for EF-2 and hardwire the damper so that on a start command from the BMS, the damper opens. Once the damper end-switch proves that the damper is open, the fan starts.

.4 MUA-2 consists of an outside air damper, a filter section, a direct fired gas heating section a supply fan and a BACnet controller.

.5 System Start/Stop

.1 MUA-2 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 On system startup, the supply fan and exhaust fan EF-2 shall be energized. Once EF-2 status is proven, MUA-2 heating shall be enabled.

.3 Should either fan fail, the system shall be disabled and an alarm shall be generated on the graphics.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be reset by the average space heating demand.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.7 Alarms

.1 The ECMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.10 Tech Service Wing Makeup Air Unit MUA-3

.1 Makeup air unit MUA-3 is a constant volume, 100% outside air system providing makeup air to the tech service wing.

.2 Heating for the individual zone is provided by radiation located in each zone.

.3 The exhaust for the wing is ducted to exhaust fans EF-10A and EF-10B. Provide motorized dampers for EF-10A and EF-10B and hardwire the damper so that on a start command from the BMS, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts.

.4 MUA-3 consists of an outside air damper, a filter section, an indirect gas heating section, a supply fan and a BACnet controller.

.5 System Start/Stop

.1 MUA-3 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 On system startup, the supply fan and exhaust fans EF-10A and EF-10B shall be energized.

.3 Should either fan fail, the system shall be disabled and an alarm shall be generated on the graphics.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be reset by the average space heating demand.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.7 Alarms

1. The ECMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.11 Trades Wing Makeup Air Unit MUA-4

.1 Makeup air unit MUA-4 is a constant volume, 100% outside air system providing makeup air to the Trades Wing.

.2 Heating for the individual zone is provided by radiation and or gas fired unit heaters located in each zone.

.3 The exhaust for the washrooms is ducted to exhaust fans EF-11 and EF-24. Provide a motorized damper for EF-11 and hardwire the damper so that on a start command from the BMS, the damper opens. Once the damper end-switch proves that the damper is open, the fan starts. EF-24 will be interlocked with the washroom lights.

.4 MUA-4 consists of an outside air damper, a filter section, an indirect gas heating section, a supply fan and a BACnet controller.

.5 System Start/Stop

.1 MUA-4 will normally be energized via the Building Automation System on a scheduled occupied/unoccupied basis. The unit shall normally be disabled during unoccupied hours.

.2 On system startup, the supply fan and exhaust fan EF-11 shall be energized.

.3 Should either fan fail, the system shall be disabled and an alarm shall be generated on the graphics.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be reset by the average space heating demand.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.7 Alarms

1. The ECMS system to provide alarms for fan failure, temperature outside of alarm limit and filter loading.

.12 North Bay Makeup Air Unit MUA-5

.1 Makeup air unit MUA-5 is a constant volume, 100% outside air system providing makeup air to the North Bay.

.2 Heating for the individual zone is provided by unit heaters located throughout the space.

.3 General exhaust for the bay is provided by exhaust fan EF-14 with motorized hose reel exhaust being provided by EF-17 and EF-18. Provide motorized dampers for EF-14, EF-17 and EF-18 and hardwire the dampers so that on a start command, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts.

.4 MUA-5 consists of an outside air damper, a filter section, a direct fired gas heating section, a supply fan and a BACnet controller.

.5 System Start/Stop

.1 The system will normally be energized at low volume via the existing 7 day programmable thermostat.

.2 On system startup, the supply fan shall be started in low speed and exhaust fan EF-14 shall be energized.

.3 Exhaust fans EF-17 and EF-18 shall be manually started by manual switches located in the space. When the exhaust fans are operating, MUA-5 supply fan speed shall be increased to provide the additional makeup air.

.4 Should the existing NO2 or CO sensors detect high gas levels, MUA-5 shall be enabled at high volume and exhaust fans EF-14, EF-17 and EF-18 shall be started.

.5 Should any one of the fans fail, the system shall be disabled and an alarm shall be generated.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be manually settable at the remote panel located in the space.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.13 North Bay Makeup Air Unit MUA-6

.1 Makeup air unit MUA-6 is a constant volume, 100% outside air system providing makeup air to the North Bay.

.2 Heating for the individual zone is provided by unit heaters located throughout the space.

.3 General exhaust for the bay is provided by exhaust fans EF-15 and EF-16 with motorized hose reel exhaust being provided by EF-19 and EF-20. Provide motorized dampers for EF-15, EF-16, EF-19 and EF-20 and hardwire the dampers so that on a start command, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts.

.4 MUA-6 consists of an outside air damper, a filter section, a direct fired gas heating section, a supply fan and a BACnet controller.

.5 System Start/Stop

.1 The system will normally be energized at low volume via the existing 7 day programmable thermostat.

.2 On system startup, the supply fan shall be started in low speed and exhaust fans EF-15 and EF-16 shall be energized.

.3 Exhaust fans EF-19 and EF-20 shall be manually started by manual switches located in the space. When the exhaust fans are operating, MUA-6 supply fan speed shall be increased to provide the additional makeup air.

.4 Should the existing NO2 or CO sensors detect high gas levels, MUA-6 shall be enabled at high volume and exhaust fans EF-16, EF-16, EF19 and EF-20 shall be started.

.5 Should any one of the fans fail, the system shall be disabled and an alarm shall be generated.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be manually settable at the remote panel located in the space.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.14 Machine Shop Makeup Air Unit MUA-7

.1 Makeup air unit MUA-7 is a constant volume, 100% outside air system providing makeup air to the North Bay.

.2 Heating for the individual zone is provided by unit heaters located throughout the space.

.3 General exhaust for the bay is provided by exhaust fans EF-12 and EF-13 with welding exhaust being provided by EF-23. Provide motorized dampers for EF-12, EF-13 and EF-23 and hardwire the dampers so that on a start command, the dampers open. Once the damper end-switch proves that the damper is open, the fan starts.

.4 MUA-7 consists of an outside air damper, a filter section, a direct fired gas heating section, a supply fan and a BACnet controller.

.5 System Start/Stop

.1 The system will normally be energized at low volume via the existing 7 day programmable thermostat.

.2 On system startup, the supply fan shall be started in low speed and exhaust fans EF-12 and EF-13 shall be energized.

.3 Exhaust fan EF-23 shall be manually started by a four hour crank timer located in the space. When the exhaust fan is operating, MUA-7 supply fan speed shall be increased to provide the additional makeup air.

.4 Should the existing NO2 or CO sensors detect high gas levels, MUA-7 shall be enabled at high volume and exhaust fans EF-12, EF-13 and EF-23 shall be started.

.5 Should any one of the fans fail, the system shall be disabled and an alarm shall be generated.

.6 Temperature Control

.1 The unit supplied controls shall control the gas heater to maintain the supply air temperature setpoint initially set at 13°C. The supply air temperature setpoint shall be manually settable at the remote panel located in the space.

.2 Heating shall be disabled when the outside air temperature is above the supply air temperature setpoint.

.15 Radiation and Reheats

.1 A space temperature sensor shall provide the signal to modulate the radiation two-way control valve to maintain the desired space temperature setpoint.

.2 Day/night mode selection through EMCS. The night mode setpoint is reset to 17°C.

.3 Where reheat coils serve the same zone as radiation, the reheat coil valve shall be modulated to maintain the supply air temperature setpoint. The supply air temperature setpoint shall be reset between 13°C and the space temperature setpoint before the radiation valve starts to modulate.

.4 Implement optimum start heating for room temperature control. The program is self adapting and starts equipment based on the calculated warm-up time for the current indoor and outdoor temperatures. Maximum optimum start time shall be 3 hours.

.16 Unit Heaters and Force Flow Heaters

.1 The force flows shall be controlled by the EMCS system. A space temperature sensor shall provide the signal to cycle the fan and 2- way control valve to maintain the desired space temperature setpoint. Entrance heaters shall have a space temperature setpoint initially set at 15°C.

.2 An aquastat located on the return heating water line of entrance force flows shall stop the fan and open the 2-way control valve 100% upon sensing a low return water temperature.

.17 Combustion Unit Heater

.1 When the outside air temperature falls below 4°C, the combustion air unit heater fan shall operate continuously and the valve shall be modulated to maintain the mechanical room heating space temperature setpoint initially set at 18°C.

.2 When the outside air temperature rises below 6°C, the combustion air unit heater valve shall be modulated to maintain the mechanical room heating space temperature setpoint initially set at 18°C. When the valve is more than 10% open for 5 minutes, the combustion air unit heater fan shall operate. Provide minimum on/off times to prevent excessive cycling of the fan.

.3 When the occupancy switch located on the space temperature sensor is manually pressed, the space temperature setpoint shall be set at 21°C for 2 hours adjustable on the graphics.

.18 Electrical Room Exhaust Fan EF-9

.1 Exhaust fan EF-9 shall be cycled to maintain the electrical room space temperature setpoint.

.19 Exhaust Fan Motorized Dampers

.1 On any roof or wall penetrations a motorized damper is required to be interlocked with the exhaust fan. EMCS system shall open the motorized damper first, and when end switch on the damper actuator indicates the damper is open the fan shall be allowed to start.

.20 OUTSIDE AIR TEMPERATURE

.1 Several OAT calculated values shall be used for control references. These calculated values will be determined from the two hardware outdoor air temperature sensors. An individual OAT sensor that is determined to be in error will not be used in determination of the calculated values, and shall be flagged as such. Upon loss of communications, the last updated value in the SCU shall be used in all control sequences within the SCU and its associated ASCs and shall be retained in the SCU's programs after a power failure within the SCU.

.2 Provide an average value, lowest value and highest value of the two outside air sensors, calculated every 2 minutes, with the calculated values being distributed to each SCU every 3 minutes.

.3 A system display showing the building outline and sensor location shall be created to display the instantaneous sensor values, the calculated average, highest and lowest value.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Read this Section in conjunction with Section 25 05 01 - EMCS General Requirements and other related EMCS Sections.

1.2 DEFINITIONS

.1 A point is a specific software address which is resident in either the RCU or TCU and which is identified with a particular field sensor, instrument, relay or actuator.

.2 The point schedule contains a list and description of the points to be connected.

.3 The relationships between the points, systems and building are described in the control sequences, Section 25 09 01.

1.3 SCHEDULES

.1 Following is appended to and forms part of this Section:

.2 Energy Management Control System - Point Database Schedule.

Part 2 Products

.1 Not used.

Part 3 Execution

3.1 POINT SCHEDULES

.1 Digital Inputs; refer to Section 25 30 02, "Digital Input Devices Schedule" and input type designation in schedule.

.2 Digital Outputs; refer to Section 25 30 02, "Digital Output Devices Schedule" and output type designation in schedule.

.3 Analog Inputs; refer to Section 25 30 02, "Analog Input Sensors Schedule" and input type designation in schedule. Consult with minister's representative during the system start-up for limits and alarm values to be entered.

.4 Analog Outputs; refer to Section 25 30 02, "Analog Output Devices Schedule" and output type designation in schedule.

.5 Use Alberta Infrastructure “EMCS Guideline for Logical Point Mnemonics” to identify each physical and virtual point in data base and User Control Language software in each panel.

.6 All points included under the same group letter must reside within the same panel. Any form of inter panel communications link to accomplish this is not allowed.

.7 Consult with the Minister during the shop drawing stage to finalize the physical terminal address of each point within each RCU or TCU.

3.2 POINT INSTALLATION

.1 When two outdoor air temperature sensors are specified, locate the sensors so that the sun cannot shine on both sensors at once, and airborne waste heat cannot simultaneously affect both sensors.

.2 Locate duct temperature and humidity sensors a minimum of three metres downstream of humidifiers.

.3 Use averaging sensors for all mixed air temperature sensing applications.

.4 Use averaging temperature sensors for applications where the duct area is greater than 0.5 m2 AND the sensor is located downstream of a coil by a distance less than 4 times the diagonal measurement of the coil.

.5 For all sensors in piping, use thermal conducting compound to ensure proper thermal coupling of sensor to well body.

1. Heating Water System									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Typical for Boilers B-1 & B-2									
Enable	Ry	X							Note #2
Status	St			X					
Flame Failure	St			X					
Supply Wtr Temp.	Tw						H/L	X	Note #1
Return Wtr Temp.	Tw						H/L	X	Note #1
Firing Rate	Mp						H/L	X	Note #1
Setpt Reset	Ao				X				Note #2
Typical for Pumps P-1 & P-2									
Enable	Ry							X	Note #1
Status	Ct				X				
Field Points									
Return Water Temp	Tw					X	H/L		
Supply Water Temp	Tw					X	H/L		
Heating System Pressure	Ps					X	H/L		
Boiler Emergency Shutdown Switch	Dc		X						

Note #1: Mapped point to BMS graphic via unit supplied BACnet card.

Note #2: Provide one point to master boiler or pump.

2. Trades Compound Secondary Heating Loop									
Point Description	Point Type	Digital			Analog			Mapped Points	Remarks
		Output	Input	**Alarm**	Output	Input	Alarm		
Typical for Htg Pumps P-3 & P-4									
Enable	Ry	X							
Speed Command	VFD				X				
Speed	VFD					X			
Alarm	Dc		X						
KW								X	Note #1
Field Points									
Heating Water Return Temp	Tw					X	H/L		
Heating Water Supply Temp	Tw					X	H/L		
Differental Pressure	Dp					X			
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

3. Warden Compound Secondary Heating Loop									
Point Description	Point Type	Digital			Analog			Mapped Points	Remarks
		Output	Input	**Alarm**	Output	Input	Alarm		
Typical for Htg Pumps P-5 & P-6									
Enable	Ry	X							
Speed Command	VFD				X				
Speed	VFD					X			
Alarm	Dc		X						
KW								X	Note #1
Field Points									
Heating Water Return Temp	Tw					X	H/L		
Heating Water Supply Temp	Tw					X	H/L		
Differental Pressure	Dp					X			
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

4. Domestic Hot Water									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Return Water Pump									
Enable	Ry	X							
Status	Ct					X			
Field Points									
Supply Water Temp	Tw					X	H/L		

5. South Office Air System AHU-1									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Speed Command	VFD							X	Note #1
Speed	VFD					X			
Alarm	Dc							X	Note #1
Return Fan									
Enable	Ry							X	
Speed Command	VFD							X	Note #1
Speed	VFD					X			
Alarm	Dc							X	Note #1
Field Points									
Mixed Air Dampers	Dm							X	Note #1
Mixed Air Temp	Ta						H/L	X	Note #1
Summer Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Heat Enable	Ry							X	Note #1
Supply Air Temperature Setpoint	Vm							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Return Air Temp	Tp					X	H/L		Note #1
Exhaust Fan EF-3									
Start/Stop	Ry	X							
Status	Ct					X			
Exhaust Fan EF-8									
Status	Ct					X			
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

6. West Office Air System AHU-2									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Speed Command	VFD							X	Note #1
Speed	VFD					X			
Alarm	Dc							X	Note #1
Return Fan									
Enable	Ry							X	
Speed Command	VFD							X	Note #1
Speed	VFD					X			
Alarm	Dc							X	Note #1
Field Points									
Mixed Air Dampers	Dm							X	Note #1
Mixed Air Temp	Ta						H/L	X	Note #1
Summer Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Heat Enable	Ry							X	Note #1
Supply Air Temperature Setpoint	Vm							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Return Air Temp	Tp					X	H/L		Note #1
Exhaust Fan EF-7									
Start/Stop	Ry	X							
Status	Ct					X			
Exhaust Fan EF-6									
Status	Ct					X			
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

7. Storage Office Air System AHU-3									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Speed Command	VFD							X	Note #1
Speed	VFD					X			
Alarm	Dc							X	Note #1
Return Fan									
Enable	Ry							X	
Speed Command	VFD							X	Note #1
Speed	VFD					X			
Alarm	Dc							X	Note #1
Field Points									
Mixed Air Dampers	Dm							X	Note #1
Mixed Air Temp	Ta						H/L	X	Note #1
Summer Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Heat Enable	Ry							X	Note #1
Supply Air Temperature Setpoint	Vm							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Return Air Temp	Tp					X	H/L		Note #1
Exhaust Fans EF-21 & EF-22									
Start/Stop	Ry	2							
Status	Ct					2			
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

8. Basement Locker Room Makeup Air MUA-1									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Status	Ct					X			
Exhaust Fan EF-1									
Enable	Ry	X							
Status	Ct					X			
Field Points									
Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Supply Air Temp Setpoint	V							X	Note #1
Heat Enable	Ry							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

9. Level 1 Warehouse Makeup Air MUA-2									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Status	Ct					X			
Exhaust Fan EF-2									
Enable	Ry	X							
Status	Ct					X			
Field Points									
Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Supply Air Temp Setpoint	V							X	Note #1
Heat Enable	Ry							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

10. Tech Service Wing Makeup Air MUA-3									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Status	Ct					X			
Exhaust Fans EF-10A & EF-10B									
Enable	Ry	2							
Status	Ct					2			
Field Points									
Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Supply Air Temp Setpoint	V							X	Note #1
Heat Enable	Ry							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

11. Trade Wing Makeup Air MUA-4									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Supply Fan									
Enable	Ry	X							
Status	Ct					X			
Exhaust Fan EF-11									
Enable	Ry	1							
Status	Ct					1			
Field Points									
Filter	Ps						H	X	Note #1
Supply Air Temp	Ta						H/L	X	Note #1
Supply Air Temp Setpoint	V							X	Note #1
Heat Enable	Ry							X	Note #1
Freezestat (Low temp Alarm)	Fz			X				X	Note #1
Note #1: Mapped point to BMS graphic via unit supplied BACnet card.									

12. Zone Controls									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
Radiation & Reheats									Note #1
Space Temp	Ts					X	H/L		
Space Temp Setpoint	Ts					X			
Radiation Valve	Vm				X				
Supply Air Temp	Ta						H/L	X	Note #2
Reheat Valve	Vm				X				Note #2
Combustion Unit Heater									Note #1
Fan/Valve Enable	Ry	X							
Valve Command	Vm				X				
Space Temp	Ts					X	H/L		
Force Flow and Unit Heater									Note #1
Fan/Valve Enable	Ry	X							
Space Temp	Ts					X	H/L		
Exhaust Fan EF-9									
Space Temp	Ts					X	H/L		
Space Temp Setpoint	Ts					X			
Enable	Ry	1							
Status	Ct					1			

Note #1: Refer to mechanical drawings for quantities.
Note # 2: Where reheat coils are specified.

13. Miscellaneous Points									
Point Description	Point Type	Digital			Analog			Mapped Points	**Remarks**
		Output	Input	**Alarm**	Output	Input	Alarm		
OAT - 1	To					X			
OAT - 2	To					X			
Normal Power	Dc	X							
Fire Alarm	Dc	X							
Sump Pump Alarms	Dc	X							Note #1
Note #1: Refer to mechanical drawings for quantities.									

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section Includes:

.1 General requirements that are common to NMS sections found in Division 26.

1.2 REFERENCES

.1 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 CSA C22.1-15, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 Electrical and Electronic Manufacturers Association of Canada. (EEMAC)

.3 National Electrical Manufactures Association. (NEMA).

.4 Insulated Power Cable Engineers Association (IPCEA)

.5 Electrical Commissioning – Refer to RSR (Third Party Commissioning agent for requirements.

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 review and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4 Submit 3 of copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.

.5 If changes are required, notify Departmental Representative of these changes before they are made.

.3 Certificates:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction and/or inspection authorities for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative

.4 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

.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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 Replace defective or damaged materials with new.

.3 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates or label for control items in English and French.

.4 Use one nameplate or label for each language.

2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction and inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authority and Departmental Representative

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates lamicoid matt white finish, black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered 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 coding: to CSA C22.1-15

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Prime	Auxiliary
Yellow	
Yellow	Green

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish.

.2 Paint indoor switchgear and distribution enclosures light gray.

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 installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 -15 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical rooms on latch side of door.

3.6 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Wall receptacles:

.1 General: 300mm.

.2 In mechanical rooms: 1200 mm.

.2 Panelboards: as required by Code

.3 Shall comply with CSA B651-12

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.4 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 Carry out tests in presence of Departmental Representative.

.4 Provide instruments, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.6 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Certified wood.

.8 Low-emitting materials.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3-09 (R2014), Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

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

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 NEMA to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for stranded copper conductors bar.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

2.2 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RWU90.

Part 3 Execution

3.1 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.

.3 Conductor length for parallel feeders to be identical.

.4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34.

.2 In trenches in accordance with Section 26 05 44.

Part 4 Execution

4.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2 NEMA.

4.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 20 –Wire and Box Connectors – 0-1000V

1.2 REFERENCES

.1 CSA C22.2 No .0.3-09 (R2014), Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

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

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

Part 3 Execution

3.1 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.

.3 Conductor length for parallel feeders to be identical.

.4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.6 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.

.7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 In trenches in accordance with Section 26 05 44.

3.3 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduits

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for connectors and terminations.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 65-13. Wire Connectors.

.2 CSA C22.2 No.41-13 (R1999), Grounding and Bonding Equipment.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

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

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

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Engineer.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

.1 Copper compression connectors to CSA C22.2No.65-13 as required sized for conductors.

.2 2 way joint boxes dry location type in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

.3 Use VFD connectors OR connector rated for Class II, Groups E, F and G hazardous locations between VFDs and motor connections.

Part 3 Execution

3.1 INSTALLATION

.1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.

.2 Install VFD connectors between VFDs and motor connections.

.3 Bond and ground as required to CSA C22.2No.41-13.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.2 WASTE MANAGEMENT AND DISPOSAL

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

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

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

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

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

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

.3 Insulated grounding conductors: green.

.4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

- .1 Grounding and bonding bushings.
- .2 Protective type clamps.
- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.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 ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly clean bonding wire to exterior of flexible conduit.

.7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.8 Connect building structural steel and metal siding to ground by welding copper to steel.

.9 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end and load end.

.10 Ground secondary service pedestals.

.11 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

.12 Connect building structural steel and metal siding to ground by welding copper to steel.

.13 Make grounding connections in radial configuration only, with connections terminating at single grounding point .Avoid loop connections.

.14 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end

.15 Ground secondary service pedestals.

3.2 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 208V system

3.3 EQUIPMENT GROUNDING

.1 Install grounding 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, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.4 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 WASTE MANAGEMENT AND DISPOSAL

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

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

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

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

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

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels at 3000m on centre spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

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

Part 2 Products

2.1 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat or turned edge covers.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1-15

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.1-2015, Canadian Electrical Code, Part 1.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1-15

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

2.3 CONDUIT BOXES

.1 Cast FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.5 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18-06, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.

.2 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.3 CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.

.4 CSA C22.2 No. 211.2-06 (R2016), Rigid PVC (Unplasticized) Conduit.

.5 CAN/CSA C22.2 No. 227.3-05 (R2010), Flexible Non-metallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal, and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

Part 2 Products

2.1 CONDUITS

.1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.

.2 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.3 Flexible metal conduit: to CSA C22.2 No. 56, steel aluminum liquid-tight flexible metal.

.4 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

2.2 CONDUIT FASTENINGS

.1 One hole malleable iron straps to secure surface conduits NPS 2 50 mm and smaller.

.1 Two hole steel straps for conduits larger than NPS 2 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 3000 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for NPS 1 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.

.1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.

.3 Surface mount conduits except as indicated on the drawing.

.4 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.

.5 Use rigid PVC conduit underground in corrosive areas.

.6 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without a prewired outlet box connection to surface or recessed fluorescent fixtures work in movable metal partitions.

.7 Minimum conduit size for lighting and power circuits: NPS 3/4 19 mm.

.8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.9 Mechanically bend steel conduit over 19 mm dia.

.10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.11 Install fish cord in empty conduits.

.12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

.2 Insulated Cable Engineers Association, Inc. (ICEA)

1.3 WASTE MANAGEMENT AND DISPOSAL

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

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

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

.4 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.5 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental representative.

.6 Do not dispose of preservative treated wood through incineration.

.7 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.8 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental representative

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

Part 2 Execution

2.1 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

2.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megaohms.

.5 Pre-acceptance tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing in accordance with manufacturer's ICEA recommendations.

.4 Leakage Current Testing.

.1 Raise voltage in steps from zero to maximum values as specified by ICEA for type of cable being tested.

.2 Hold maximum voltage for specified time period by ICEA manufacturer.

.3 Record leakage current at each step.

.7 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures.

.2 26 05 00 – Common Work Results for Electrical

1.2 REFERENCES

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 Electrical and Electronic Manufacturers Association of Canada. (EEMAC)

.3 National Electrical Manufactures Association. (NEMA).

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 motor control centres]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 Province of Alberta, Canada.

.2 Indicate on drawings:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable and Bus entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams.

Part 2 Products

.1 Provide bucket in the existing MCC to match existing manufacturer.

.2 Provide conduit, wiring, starter, as required to feed new equipment from existing MCC. If space is limited in existing MCC supply new MCC as required to feed the equipment. MCC manufacturer to be from the list stated below; include new MCC and all associated electrical equipment in your bid for consideration. No additional fee will be accommodated after Tender closes.

.3 Eaton Cutler-Hammer Series 2.

.4 Siemens.

.5 Allen Bradley.

.6 Approved equals

2.2 SUPPLY CHARACTERISTICS

.1 208 V, 60 Hz, delta connected, 3 phase, 3 wire, grounded.

2.3 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Indoor CSA 1gasketted enclosure, front, or back to back mounting.

.4 Class I, Type A.

2.4 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 165 mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top or bottom with terminals .

.8 Provision for outgoing cables to exit via top or bottom with terminals.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to site complete with hardware and instructions for re-assembly.

2.5 GROUND BUS

.1 Copper ground bus extending entire width of motor control centre.

2.6 MOTOR STARTERS AND DEVICES

2.7 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.8 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.9 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 6 05 00 - Common Work Results for Electrical.

.1 Individual compartment nameplates: size No. 5, engraved as indicated.

2.10 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Paint motor control centre exterior light gray and interiors white.

Part 3 Execution

3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload heater elements are installed.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

.1 CSA International

.1 CAN/CSA C22.2 No.94.1-15, Enclosures for Electrical Equipment, Non Environment Considerations.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).

.3 The Munsell System of Colour Notation

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for [electrical cabinets and enclosures] for incorporation into manual.

1.5 MATERIALS

.1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.

.2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m^2 area without rupture of material.

.3 Removable enclosure panels with formed edges galvanized steel external fasteners removable only from inside enclosure.

.4 Equip enclosure with hot dipped galvanized mounting rails 1 m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.

.1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.

.2 Holes in side panel flanges in 60 mm increments for vertical adjustment.

.5 Cover: tamperproof, bolt-on, domed to shed water.

.6 Door: 3 point latching, with padlocking means.

.7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.

Part 2 Execution

2.1 INSTALLATION

.1 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.

.2 Mount equipment in enclosure.

.3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

2.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wiring devices

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 30 - Health and Safety Requirements.

.3 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 01 - Common Work Results - Electrical.

Part 2 Products

2.1 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:

- .1 Ivory urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

- .1 Ivory urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.2 COVER PLATES

.1 Cover plates for wiring devices to: CSA C22.2 No.42.1.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Stainless steel, vertically brushed, 1 mm thick cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

.4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

2.3 SOURCE QUALITY CONTROL

.1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 INSTALLATION

.1 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height as indicated and in accordance with Section 26 05 00 - Common Work Results for Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Install GFI type receptacles as indicated.

.2 Cover plates:

.1 Install suitable common cover plates where wiring devices are grouped.

.2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 27 26 - Wiring Devices

.3 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 01 - Common Work Results - Electrical.

Part 2 Products

2.1 MATERIALS

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144 and NEMA PG 2.2.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single and Two pole ground fault circuit interrupter for 20 A, 125 V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT LIFE PROTECTOR

.1 complete with:

.1 Automatic shunt trip breaker.

.2 Zero sequence current sensor.

.3 Facilities for testing and reset.

.4 CSA Enclosure 1 and 3 surface mounted or as required.

.5 Ground fault trip indicator light.

2.4 GROUND FAULT PROTECTOR UNIT

.1 Self-contained with 15 A, 120 V circuit interrupter and duplex] receptacle complete with:

.1 Solid state ground sensing device.

.2 Facility for testing and reset.

.3 CSA Enclosure 1, surface or flush mounted with stainless steel face plate.

Part 3 Execution

3.1 INSTALLATION

.1 Do not ground neutral on load side of ground fault relay.

.2 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for non-fused disconnect switches.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 30 - Health and Safety Requirements.

.3 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 01 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-16, Enclosed Switches.

.2 CSA C22.2 No.39-13 (R2003), Fuseholder Assemblies.

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.5 HEALTH AND SAFETY

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

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

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

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

.4 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.

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

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Non-fusible, Horsepower rated disconnect switch in CSA enclosure to CAN/CSA-C22.2 No.4 size as required

.2 Provision for padlocking in on-off switch position by 3 locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.5 Quick-make, quick-break action.

.6 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 26 24 19 - Motor Control Center.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1-[latest edition], Part 4: Electromechanical contactors and motor-starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures].

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Alberta Canada.

.2 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

Part 2 Products

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR STARTERS

.1 Single or Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or Three overload heaters, manual reset, trip indicating handle.

.2 Accessories:

.1 Pushbutton, Toggle or Key switch: or as labelled on mechanical schedule.

.2 Indicating light: standard, heavy duty as indicated on mechanical schedule

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic, combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch , circuit breaker with operating lever on outside of enclosure to control disconnect, circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons, Selector switches or as indicated on the mechanical schedule:

.2 Indicating lights: standard or heavy duty or as indicated on mechanical schedule.

.3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 ACCESSORIES

.1 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.6 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

APPENDIX A

File No. 33374.00

August 21, 2015

Via Email:

Riddell Kurczaba
2530 Hochwald Ave. SW
Calgary, AB, T3E 7H5

Attention: Terry Bertocchi
Project Manager

Subject: BNP – PCA Maintenance Compound
Pre-Design Roof Condition Assessment

216 Hawk Avenue, Banff, Ablerta

Banff, Alberta

1.0 Introduction

Williams Engineering Canada Inc. was retained by Riddell Kurczaba to undertake roof condition assessments of Building 1 and the Garage Buildings at the PCA Maintenance Compound in Banff, AB. This assessment was authorized by Terry Bertocchi of Riddell Kurczaba.

2.0 Examination of Existing Conditions

A field review was conducted on August 18, 2015 by Adam Landry and Julia Beresford of Williams Engineering Canada Inc. The following is a summary of our visual observations. Please also refer to Appendix A – Roof Assessment Photographs.

Core sampling of the existing roof assemblies was not conducted during the review. Permission was requested to core sample the existing roof assemblies to determine existing components. This request was denied by onsite personnel at the time of the review.

2.1 Summary of Observed Conditions

- Previous repairs were observed at cap sheet side laps immediately adjacent to an internal roof drain on the roof of Building 1 (Photo 1).

- Diagonal wrinkling of the roof membrane was observed throughout the field of Building 1's roof (Photo 2).

- Membrane stripping laps were observed to be open and unsealed on the inside face of Building 1's parapet walls (Photo 3).

- Numerous cap sheet blisters were observed throughout the field of Building 1's roof membrane (Photo 4).

- Open and unsealed side laps in the cap sheet were observed where cross sheet membrane ridges are present on Building 1's roof (Photo 5).

- Ponding was observed between internal roof drains in the central valleys of Building 1's roof (Photo 6).

- Ponding was observed upslope of the curbed roof top units (RTUs) on the roof of Building 1 (Photo 7).

- The following existing roof assembly components were confirmed at one of Building 1's internal drain locations inside the building: wood fibreboard and expanded polystyrene insulation (Photo 8).

- The internal roof drains connect to interior rain water leaders that remove rain and melt water below grade in Building 1 and the Garage (Photo 9).

- Evidence of water intrusion was observed inside the roof access hatch on Building 1 (Photo 9).

- De-granulation of the existing cap sheet was observed immediately below the RTU service doors on Building 1 (Photo 11).

- Several abandoned roof penetration curbs are present on the roof of Building 1. All abandoned openings/curbs should be removed (if possible) and the wood deck in-filled with new matching decking (Photo 12).

- Ponding was observed on the entrance canopy roof and is a result of inadequate positive slope to the internal roof drain and possibly a blocked drain (Photo 13).

- Existing communications equipment will need to be removed from the fascia cladding and parapet wall caps of Building 1 and the Garage to allow for the removal of the existing roof components and installation of new roof assembly components (Photo 14).

- Existing communications equipment will need to be removed from the fascia cladding and parapet wall caps of Building 1 and the Garage to allow for the removal of the existing roof components and installation of new roof assembly components. (Photo 15).

- Onsite personnel reported recent water intrusion into the interior space of the building at waterproofing gum boxes. Several of these gum boxes have been recently topped-up with trowel-applied mastic (Photo 16).

- Existing B vent pipes are waterproofed via galvanized metal roof jacks, storm collars and sealant. The existing field membrane terminates on the horizontal at the base of the roof jack (Photo 17).

- Existing plumbing vent pipe penetrations are waterproofed via aluminum roof jacks complete with neoprene collars. The existing field membrane terminates on the horizontal at the base of the roof jack (Photo 18).

- Existing internal drains have recessed sumps to aid in collecting rain and melt water from the field of the roof. Consideration should be given to installing new tapered insulation drain sumps around new cast metal internal roof drains (Photo 19).

- Existing roof penetration curbs included: B vents, goose neck vents, turbine exhaust fans (Photo 20).

- Onsite personnel reported active leaks occur in the Garage immediately below the clerestory windows. Stains were observed on the inside face of the concrete block wall (Photo 21).

- The existing sealant installed between the joints of the stone window sill lintels immediately above the Garage's lower roof section has failed (Photo 22).

- The leading edges of the existing roof membrane stripping plies are open and unsealed at the base of the high walls on the Garage's lower roof section (Photo 23).

- Ponding was observed adjacent to the existing roof drains on the Garage's lower roof section (Photos 24 & 25).

- Open and unsealed parapet wall cap stripping laps were observed on the inside face of the Garage's upper roof section (Photo 27).

- Ponding was observed on the surface of the Garage roof's existing pre-finished metal parapet wall cap flashings. The colour of the metal cap flashings is faded (Photo 28).

- Past repairs were observed to have been made at the Garage roofs' internal roof drains (Photo 29).

- Expanded polystyrene insulation was observed at an internal roof drain below the Garage's upper roof (Photo 30).

- The existing roof membrane stripping plies on the Garage's lower roof section are open and unsealed at the base of the stucco high walls (Photo 31).

- The existing roof hatch curb is below 200mm in height from the finished surface of the primary roof membrane on the Garage's lower roof.

- Communications equipment (and stand) rests directly on the surface of the existing cap sheet (Photo 31).

3.0 Conclusions

.1 The existing conventional (insulation under membrane) 2-ply SBS modified bitumen roof membrane assembly in Section A of Building 1 and Section 1.1 and 2.1 of the Garage, are estimated to be approximately 25 years old+ and have exceeded their expected lifespans and are entering failure mode.

.2 There is inadequate existing positive slope on the roof assemblies to effectively remove rain and melt water to the internal roof drains.

.3 Existing parapet wall caps are insufficiently sloped back into the field of the roof.

.4 Existing RTU service lines penetrate the roof assemblies via waterproofing gum boxes that required continued maintenance. These gum boxes have been a source for water intrusion into the interior space of Building1.

.5 Many of the roof penetration curbs were measured to be below 200mm height from the finished level of the existing primary roof membrane.

4.0 Recommendations

.1 The existing 2-ply SBS modified bitumen roof membrane assembly in Section A and the two entrance canopy roofs of Building 1 should be scheduled for immediate removal and replacement.

.2 The existing 2-ply SBS modified bitumen roof membrane assemblies in Sections 1.1 and 2.1 and the entrance canopy roof of the Garage building should be scheduled for immediate removal and replacement.

.3 The following new low slope roof assembly components are recommended:

- Torch-applied SBS modified bitumen cap sheet and stripping (e.g. SOPREMA's Sopralene Flam GR 250).
- Self-adhered SBS modified bitumen base sheet (SOPREMA's Sopraflash Flam Stick) with primer (e.g. SOPREMA's Elastocol Stick)
- Asphaltic cover board with factory-applied base sheet (e.g. SOPREMA's 7mm Soprasmart 180 Board) adhered in stripes of low-rise foam adhesive.
- Coated, glass-faced flat stock polyisocyanurate insulation (1220mm x 1220m) adhered in stripes of low-rise foam adhesive to desired thickness.
- Full taper-cut Type 2 expanded polystyrene (EPS) insulation slope package at minimum 1% (e.g. Plastispan) adhered in stripes of low-rise foam adhesive.
- Self-adhered SBS modified bitumen membrane vapour retarder (e.g. SOPREMA's Sopravap'r) with primer (e.g. SOPREMA's Elastocol Stick).
- Mechanically-fastened 6.4 mm deck levelling board (e.g. DensDeck Prime).

.4 The following representative detail drawings are recommended to be included in the drawing set for any future roof replacement project: new roof assembly components, roof drain, parapet wall and fascia, roof hatch curb, plumbing vent pipe curb, RTU curb, B vent and overhead heater exhaust pipe curb, waterproofing doghouse curb, gooseneck vent curb, air handling unit curb and turbine exhaust fan curb.

.5 Existing internal roof drains should be removed and discarded. New cast metal roof drains complete with cast metal clamping rings, cast metal debris domes and leak free connections to the existing interior rain water leaders. New roof drain bowls and interior rain water leaders should be insulated and wrapped with canvas. A mechanical review of the existing drainage including internal roof drains and scuppers from all roof sections is recommended.

.6 All roof penetrations, aside from internal roof drains, should be curbed up to a minimum height of 200mm from the finished height of the primary roof membrane.

.7 Existing RTU service line roof penetrations should be re-worked to horizontally exit through membrane stripped-in curbs, a minimum of 200mm above the finished height the primary membrane. Existing waterproofing gum boxes should be removed and discarded.

.8 Existing abandoned roof penetration curbs should be removed and discarded and the deck openings in-filled with new matching decking prior to installation of new overlying roof assembly components.

.9 The existing fascia cladding will need to be temporarily removed to allow for new parapet wall membrane stripping plies to lap over the leading edges of the fascia's existing underlying moisture barrier. Consideration should be given to replacing the existing fascia moisture barrier at this time.

.10 Parapet wall caps should be adequately sloped to promote water shed back into the field of the roof and reduce active ponding occurring in these locations.

.11 Additional SBS modified bitumen cap sheet protection pads should be installed immediately outside the roof access hatch and below all RTU service doors.

.12 New pre-finished metal parapet wall cap flashings complete with S-lock side joints and standing seam corner joints should be installed in maximum 1500mm lengths to increase clip frequency and minimize oil-canning. Cap flashing hook strips should be installed on the outside face of the fascia cladding to provide additional securement..

.13 All existing cant strips should be removed and discarded to provide 90 degree transitions for installation of new membrane stripping plies.

.14 New solid-welded, one-piece metal square-to round flashings complete with new pre-finished metal storm collars and sealant should be installed over all non-plumbing vent pipe roof penetration curbs (e.g. B vents).

.15 New conical aluminum vent cone flashings complete with neoprene collars and sealant should be installed over new plumbing vent pipe curbs and plumbing vent pipe extensions. New plumbing vent pipe extensions should project approximately 100mm up past the neoprene collars.

.16 Tapered insulation crickets should be installed upslope of all large roof penetration curbs (e.g. RTU units) to promote water migration around the curbs and to the internal roof drains.

.17 New deck levelling board can be mechanically-fastened (w/ plates and screws) over the existing wood deck to provide a new substrate for the installation of new primer and self-adhered. Deck levelling board fasteners should not penetrate the underside of the deck. Under-deck mounted equipment and electrical conduit are visible on the underside of the existing wood decks.

.18 New non-treated plywood should be installed to the inside face and caps of the parapet walls and new roof penetration curbs. Existing plywood should be removed from the inside faces of the parapet walls and discarded to allow for the installation of new batt or Roxul insulation within parapet wall stud cavities.

.19 Additional torch-applied SBS modified bitumen cap sheet protection pads and 12.7mm drainage matt should be installed below all loose-laid and ballasted communications equipment stands.

.19 All loose cables should be supported up off the surface of the finished cap sheet on rubber equipment supports complete with cap sheet protection pads..

.20 Considerations should be given to removing and discarding the existing roof access hatches and installing new roof hatch curbs (e.g. Bilco) during any future roof replacement project. Roof hatch curb drip edges must be a minimum of 200mm in height above the finished height of the primary roof membrane too allow for the termination of roof membrane stripping plies.

.21 WEC recommends a 15 year, leak-free, no dollar limit (NDL), labour, material and workmanship membrane manufacturer warranties (e.g. Soprema's Platinum Warranty).

5.0 Closure

This report has been prepared based upon the information referenced herein. It has been prepared in a manner consistent with good engineering judgement. Should new information come to light, Williams Engineering Canada Inc. requests the opportunity to review this information and our conclusions contained in this report. Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

We trust that the above report meets with your requirements. Please direct any inquiries that you may have to the undersigned.

Yours truly,

Williams Engineering Canada Inc.

ADAM LANDRY, ARCA Inspector
Building Science

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Reviewed By
Williams Engineering Canada Inc.

Randal B. Smith
08/21/15

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PERMIT TO PRACTICE
WILLIAMS ENGINEERING CANADA INC.
Signature
Date Aug. 21, 2015
PERMIT NUMBER: P10527
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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Appendix A – Survey Photographs

Photo 1 – Previous repairs were observed at cap sheet side laps immediately adjacent to an internal roof drain on the roof of Building 1.

Photo 2 – Diagonal wrinkling of the roof membrane was observed throughout the field of Building1's roof.

Photo 3 – Membrane stripping laps were observed to be open and unsealed on the inside face of Building 1's parapet walls.

Photo 4 – Numerous cap sheet blisters were observed throughout the field of Building 1's roof membrane.

Photo 5 – Open and unsealed side laps in the cap sheet were observed where cross sheet membrane ridges are present on Building 1's roof.

Photo 6 – Ponding was observed between internal roof drains in the central valleys of Building 1's roof.

Photo 7 – Ponding was observed upslope of the curbed roof top units (RTUs) in Building 1.

Photo 8 – The following existing roof assembly components were confirmed at one of the internal drain locations inside the building: wood fibreboard and expanded polystyrene insulation.

Photo 9 – The internal roof drains connect to interior rain water leaders that remove rain and melt water below grade in Building 1 and the Garage.

Photo 10 – Evidence of water intrusion was observed inside the roof access hatch on Building 1.

Photo 11 – Degranulation of the existing cap sheet was observed immediately below the RTU service doors on Building 1.

Photo 12 – Several abandoned roof penetration curbs are present on the roof of Building 1. All abandoned openings/curbs should be removed (if possible) and the wood deck in-filled with new matching decking.

Photo 13 – Ponding was observed on the entrance canopy roof and is a result of inadequate positive slope to the internal roof drain and possible a blocked drain. There is no existing emergency overflow scupper on this roof.

Photo 14– Existing communications equipment will need to be removed from the fascia cladding and parapet wall caps of Building 1 and the Garage to allow for the removal of the existing roof components and installation of new roof assembly components.

Photo 15 - Existing communications equipment will need to be removed from the fascia cladding and parapet wall caps of Building 1 and the Garage to allow for the removal of the existing roof components and installation of new roof assembly components.

Photo 16 – Onsite personnel reported recent water intrusion into th einterior space of the building at waterproofing gum boxes. Several of these gumboxes have been recently topped-up with trowel-applied mastic.

Photo 17 – Existing B vent pipes are waterproofed via galvanized metal roof jacks, storm collars and sealant. The existing field membrane terminates on the horizontal at the base of the roof jack. WEC recommends all roof penetrations are curbed up to a minmum of 200mm in height above the finished level of the new primary roof membrane.

Photo 18 – Existing plumbing vent pipe pentrations are waterproofed via aluminum roof jacks complete with neoprene collars. The existing field membrane terminates on the horizontal at the base of the roof jack. WEC recommends all roof penetrations are curbed up to a minmum of 200mm in height above the finished level of the new primary roof membrane.

Photo 19 – Existing internal drains have recessed sumps to aid in collecting rain and melt water from the field of the roof. Consideration should be given to installing new tapered insulation drain sumps around new cast metal internal roof drains.

Photo 20 – Existing roof penetration curbs included : B vents, goose neck vents, turbine exhaust fans. Detail drawings should be provided for these penetrations.

Photo 21 – Onsite personnel reported active leaks occur in the Garage immediately below the clerestory windows. Stains were observed on the inside face of the concrete block wall.

Photo 22 – The existing sealant installed between the joints of the stone window sill lintels immediately above the Garage's lower roof section has failed.

Photo 23 – The leading edges of the existing roof membrane stripping plies is open and unsealed at the base of the high walls on the Garage's lower roof section.

Photo 24 - Ponding was observed adjacent to the existing roof drains on the Garage's lower roof section.

Photo 25 – Ponding was observed adjacent to the existing roof drains on the Garage's upper roof section.

Photo 26 - Ponding was observed adjacent to the existing roof drains on the Garage's upper roof section.

Photo 27 – Open and unsealed parapet wall cap stripping laps were observed on the inside face of the Garage's upper roof section.

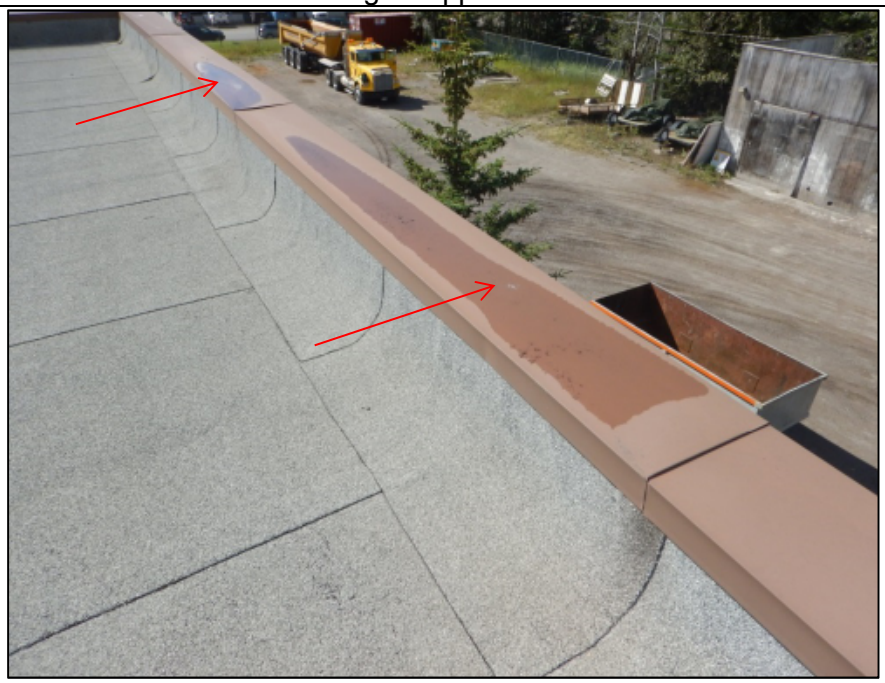


Photo 28 – Ponding was observed on the surface of the Garage roof's existing pre-finished metal parapet wall cap flashings. The colour of the metal cap flashings is faded.

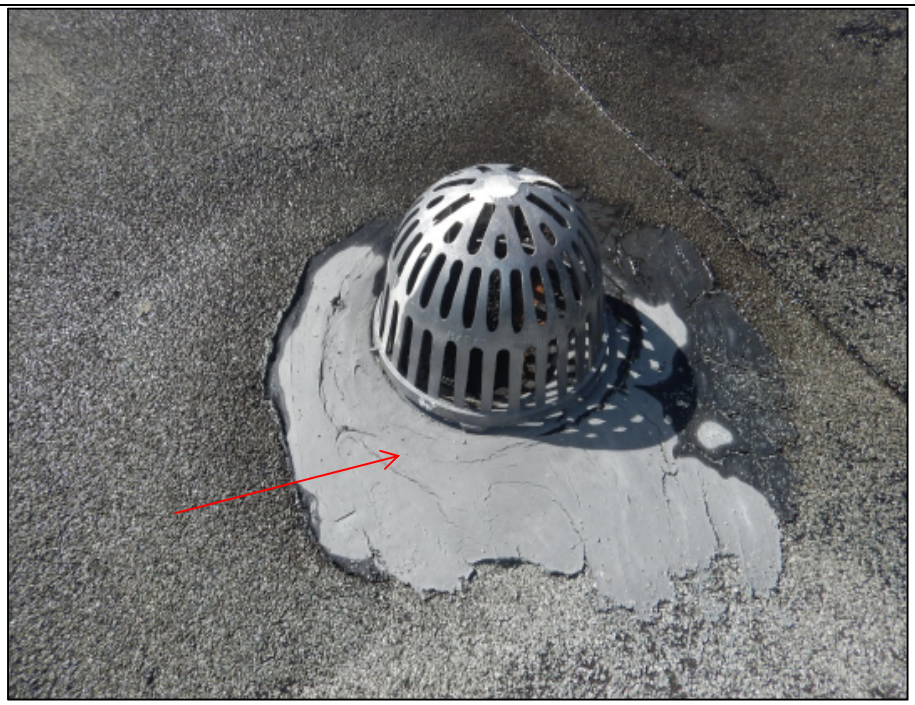


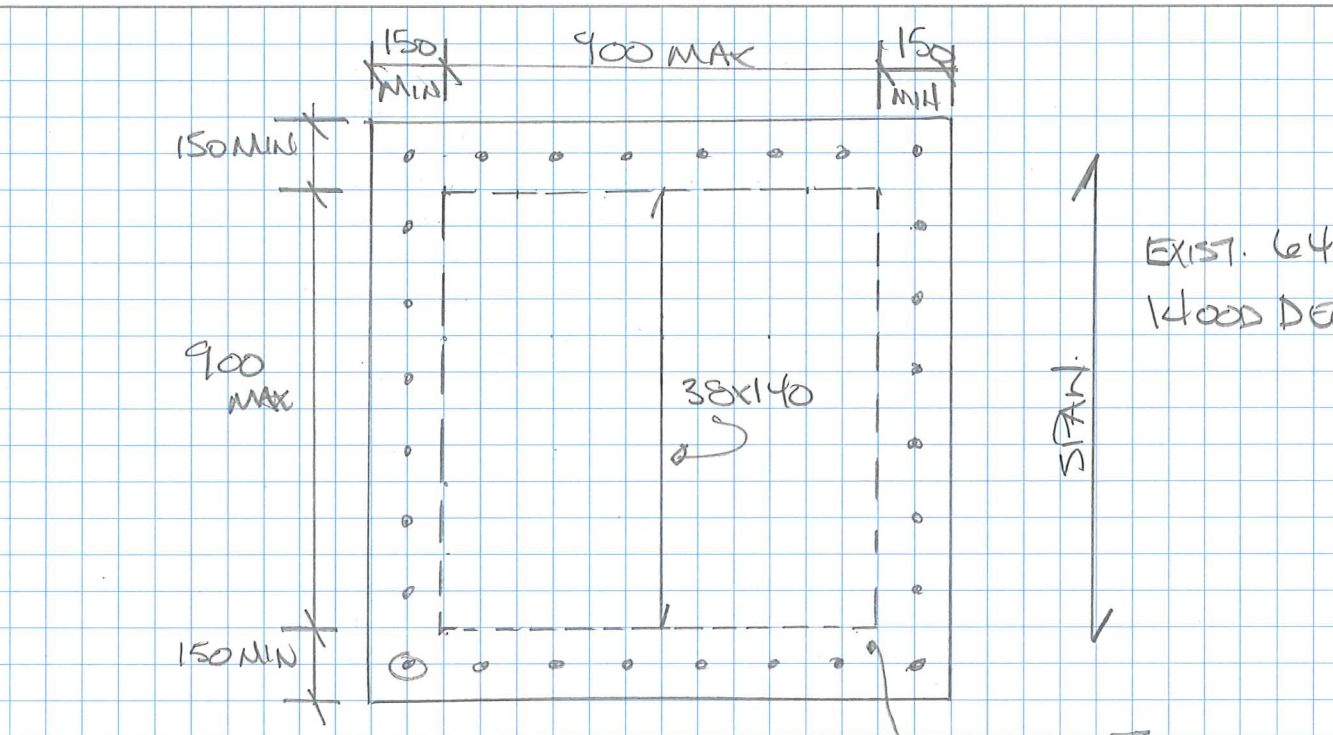
Photo 29 – Past repairs were observed to have been made at the Garage roofs' internal roof drains.

Photo 30 – Expanded polystyrene insulation was observed at an internal roof drain below the on the Garage's upper roof.

Photo 31 – The existing roof membrane stripping plies on the Garage's lower roof section are open and unsealed at the base of the stucco high walls.

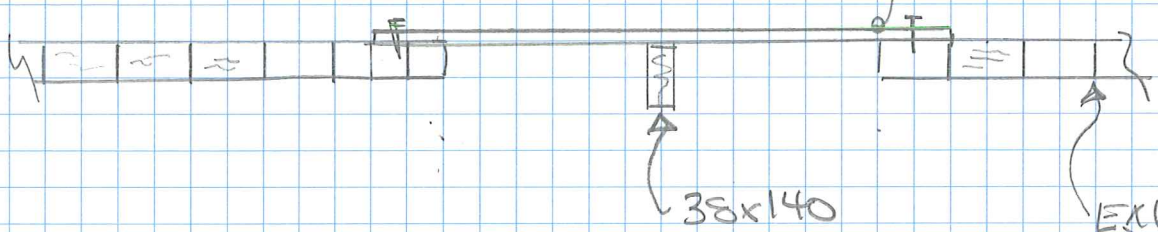
Photo 32 – The existing roof hatch curb is below 200mm in height from the finished surface of the primary roof membrane on the Garage's lower roof.

Photo 33 – Communications equipment (and stand) rests directly on the surface of the existing cap sheet.



6mm ϕ SDS Screws @ 150 o/c
OR 64 Long Nails @ 150 o/c

20mm PLYWOOD PLAIN



SECTION.

OPENINGS LESS THAN 900
TYPICAL INFILL.

PROFESSIONAL ENGINEER
MICHAEL J.J. NOWLAN
ALBERTA

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WILLIAMS ENGINEERING CANADA INC.
Signature
Date 2015/8/31
PERMIT NUMBER: P10527
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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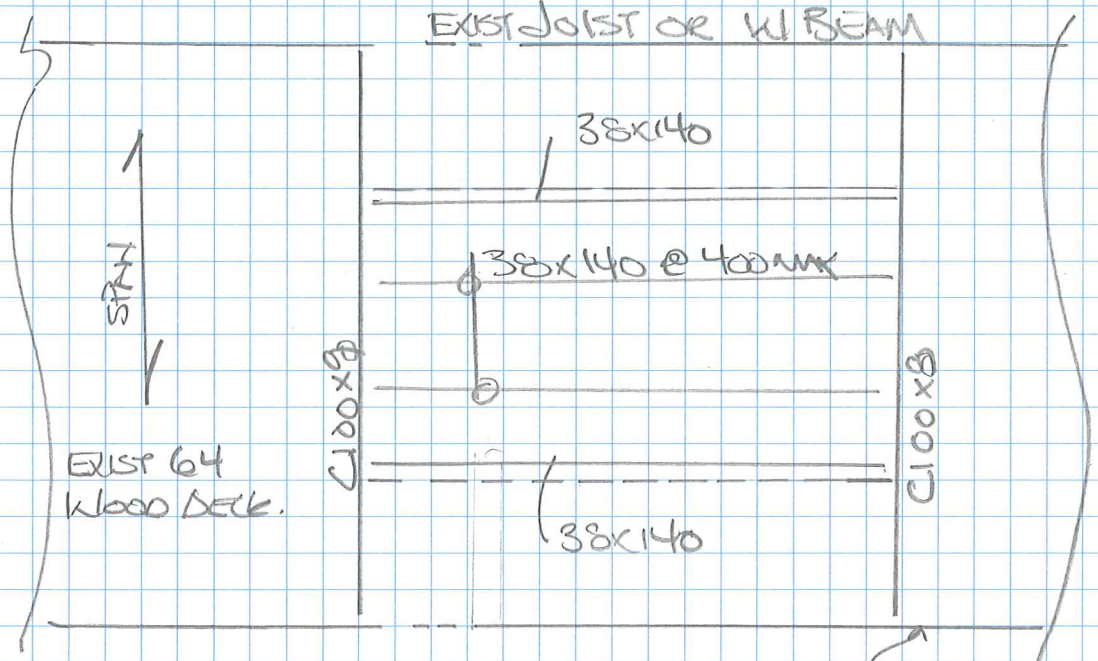
Project: ~~BANFF LOMAS WOOD~~ Roof Repair
Description: Roof Infill
Date: 2015 08 31
Page: 1 of 3

Project No. 33374
Designed By MN
Checked By MN



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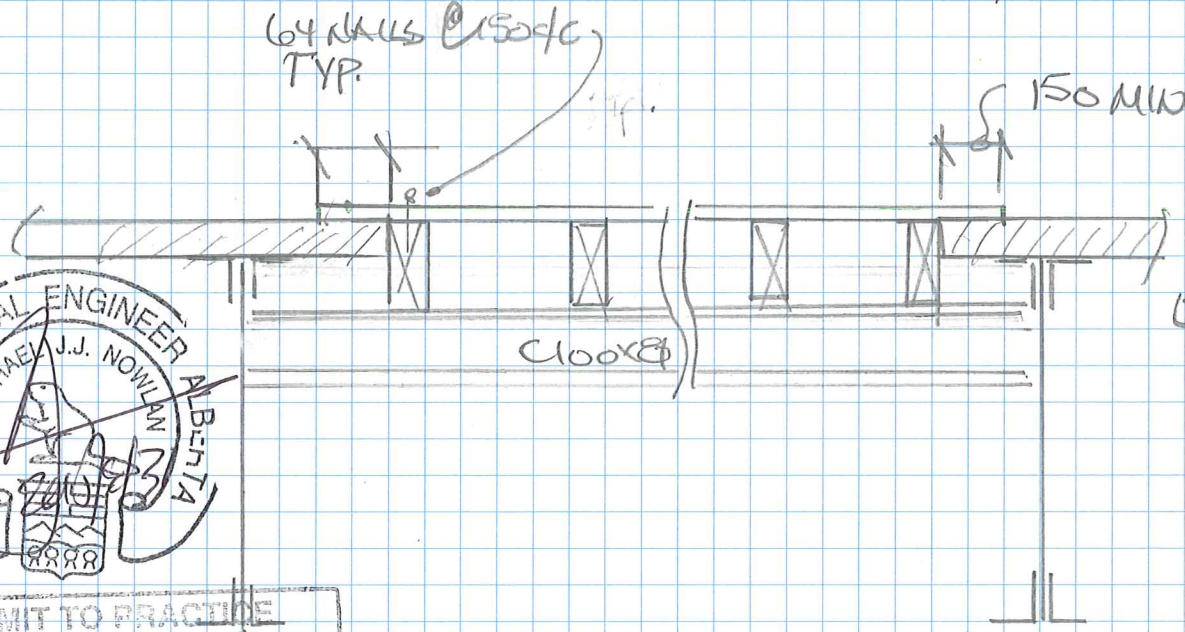

SECTION.

OPENINGS GREATER THAN 900 MAX 1600 TYPICAL INFILL.

PROFESSIONAL ENGINEER MICHAEL J.J. NOWLAN ALBERTA 2015 08 31

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Date 2015/08/31
PERMIT NUMBER: P10527
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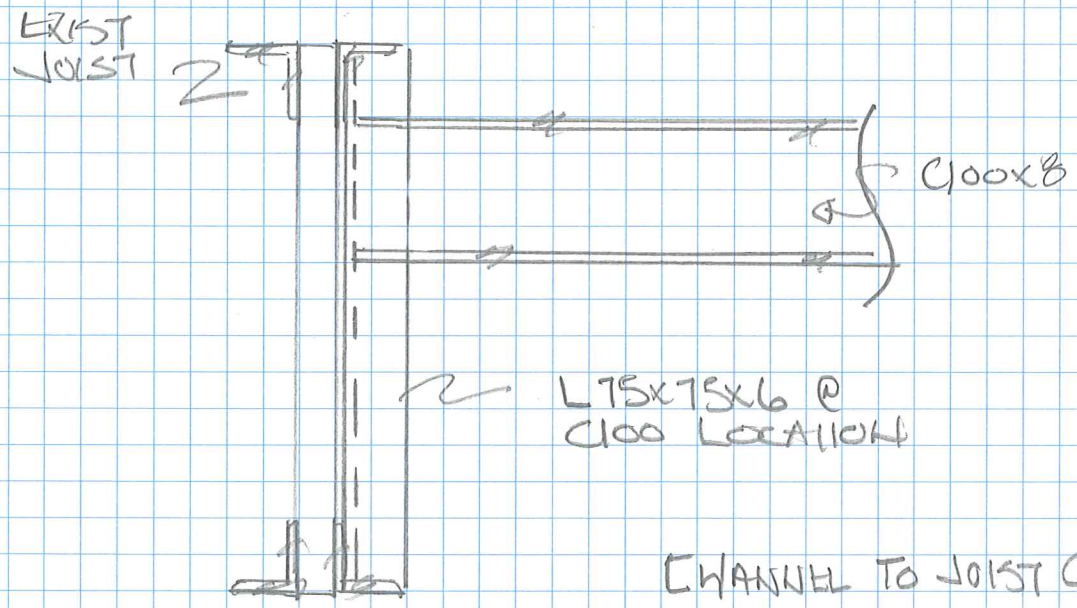
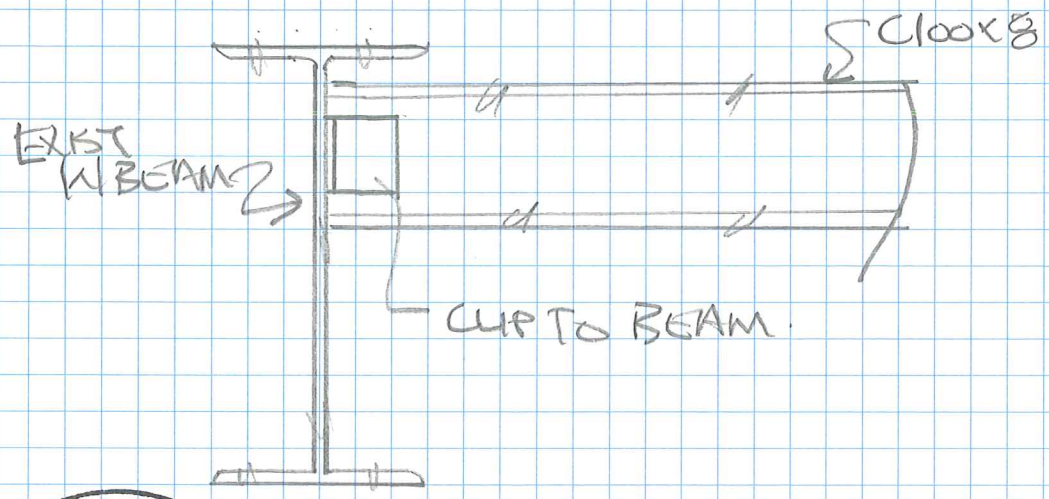
Project: Banff Compound Roof Repair	Project No. 33374
Description: Roof Infill	Designed By MN
Date: 2015 08 31	Checked By MN
Page: 2 of 3	



CHANNEL TO JOIST CONNECTION



CONNECTION CHANNEL TO BEAM.

PROFESSIONAL ENGINEER MICHAEL J.J. NOWLAN ALBERTA

PERMIT TO PRACTICE
WILLIAMS ENGINEERING CANADA INC.
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Date 2015/08/31
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Project: Banff Compound Roof Repair

Description: Roof Infill

Date: 2015 8 31.

Page: 3 of 3

Project No. 33374

Designed By MN

Checked By MN

Associated Environmental

FINAL REPORT

Parks Canada Agency

Hazardous Materials Survey
Banff Operations Compound

November 2016

ISO 9001 and 14001 Certified | An Associated Engineering Company

CANADA'S BEST MANAGED COMPANIES Platinum member

Associated Environmental

Associated Environmental Consultants Inc.
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FAX: 403.265.9103
www.ae.ca | ISO 9001 & 14001 Certified

November 17, 2016
File: 2016-3790.100

Laurie MacDonald, C.E.T., LEED AP ID+C
Technical Services Coordinator II
Banff Field Unit
Parks Canada Agency
200 Hawk Avenue
Banff, AB, T1L 1K2

Re: FINAL REPORT: HAZARDOUS MATERIALS SURVEY AT THE BANFF OPERATIONS COMPOUND: GARAGE AND TRADES/TECH/WARDEN BUILDING

Dear Ms. MacDonald:

Associated Environmental Consultants Inc. (the Environmental Division of Associated Engineering) is pleased to provide a Hazardous Materials Survey report for the above noted locations in Banff, AB.

Please call if you have any questions.

Yours truly,

Andrea Ellis
Environmental Scientist

Reviewed by,

Rebekka Lindskoog, R.P.Bio.
Manager, Environmental Management

Enclosures: Final Report

Executive Summary

Associated Environmental Consultants Inc. (Associated) accompanied by Peak Environmental Ltd. (Peak) was retained by Parks Canada Agency (PCA) in September 2016 to conduct a hazardous material survey (HMS) at the Banff Operations Compound in Banff, AB.

The objective of the survey was to conduct a HMS in order to create specifications and a construction cost estimate for hazardous materials abatement for the Banff Operations Compound (garage and trades/tech/warden buildings) roof HVAC and boiler renovation projects. The interior and exterior of the buildings were completely assessed, but only areas relevant to the specific renovation project work require abatement specifications and construction management. An intrusive (i.e., destructive) assessment to identify hazardous materials on site. This type of assessment included architectural, mechanical, electrical, and civil construction systems.

Of the 82 samples submitted for ACM analysis, 17 samples contained detectable concentrations of asbestos or were assumed to contain asbestos based on professional experience (Tables 5-1 and 5-2). Four materials which were not able to be sampled at the time of the survey were suspected to contain asbestos.

Paint was throughout each building. Of the 15 LBP samples screened on site, eight samples were above 600 mg/kg (Table 5-3) for lead.

The samples that were positive for **asbestos-containing materials** are listed below.

Material	Location	Degree/Extent of Potential Impacts During Renovation Activities
Refractory cement on boiler segments	Boiler room A106	This material will be disturbed by the boiler renovation project. The existing boiler is to be removed.
Soft, grey, exterior window putty	“A” section of the building	This material may be disturbed by any of the planned renovation projects.
Putty and sealants	Roof	This material may be affected by the roof renovation project.
Cast iron bell and spigot joint packing	“A” section of the building	This material may be disturbed by any of the planned renovation projects.

Material	Location	Degree/Extent of Potential Impacts During Renovation Activities
Boiler exhaust “B” vent through ceiling (suspect)	Boiler room A106	This material will be disturbed by the boiler renovation project. The flue vent connection from boiler will be removed. Inspection for asbestos insulation must be performed once the boiler is off and prior to demolition work.
Beige insulating cement on hot water pipe fitting	“B” section of the building	This material may be disturbed by the planned renovation projects.
Boiler exhaust breaching	Boiler room B138	This material will be disturbed by the boiler renovation project.
12x12” tan floor tiles with minimal brown streaks	“B” section of the building	This material may be disturbed by any of the planned renovation projects.
Various high velocity duct joint sealants	“B” section of the building	This material will be disturbed by the HVAC renovation project.
Soft grey exterior window putty	“B” section of the building	This material may be disturbed by any of the planned renovation projects.
Beige drywall tape compound	“B” section of the building	This material may be disturbed in areas where demolition is necessary to facilitate work.
Various sealants and putties	Roof	This material will be affected by the roof renovation project.
Cast iron bell and spigot joint packing	“B” section of the building	This material may be disturbed by any of the planned renovation projects.
Segmented cube boiler internal packing (suspect)	Boiler room B138	This material will be disturbed by the boiler renovation project. The existing boiler is to be removed.
Beige and grey insulating cement on hot water and rainwater pipe fittings	Throughout building	This material will be disturbed by any of the planned renovation projects.
12x12” tan floor tile with minimal brown streaks	Garage lunch room - 102	This material will not be disturbed by any of the planned renovation projects.
Ceiling panel (suspect)	Garage lunch room 102,	This material will not be disturbed by any of the planned renovation projects.

Material	Location	Degree/Extent of Potential Impacts During Renovation Activities
	office 110, office 111	
Black on grey roof flashing tar	Roof	This material will be affected by the roof renovation project.
Cast iron sanitary and rain water leader piping bell and spigot packing	Garage	This material may be disturbed by any of the planned renovation projects.
Pipe flange gasket	Garage boiler room - 116	This material will be affected by the boiler room renovation project.
Boiler refractory cement (suspect)	Garage boiler room - 116	This material will be affected by the boiler room renovation project. Inspection for asbestos insulation must be performed once the boiler is off and prior to demolition work.

The samples that were positive for **lead-based paint** are listed below.

Material	Location	Degree/Extent of Potential Impacts
Cream paint on exterior wood soffits	West exterior	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Cream paint on white primer on wood ceiling shiplap	Vestibule A165	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Red oxide primer on structural steel	Throughout “A” section of building	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Cream paint on concrete block wall (original colour)	Stores A154	This material may be disturbed by any of the planned renovation projects.
Cream paint on exterior wood soffits	West exterior	This material may be disturbed by any of the planned renovation projects.
Red oxide primer on structural steel	Throughout “B” section of building	This material may be disturbed by any of the planned renovation projects.

Material	Location	Degree/Extent of Potential Impacts
Red oxide primer under cream paint on structural steel	Garage - Storage 119	This material may be disturbed by any of the planned renovation projects.
Cream paint on wood shiplap ceiling	Garage - Storage 119	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Cream paint on concrete block wall	General workshop 122, north wall	This material may be disturbed by any of the planned renovation projects.
White paint over cream paint on concrete block wall	General workshop 122, north wall	This material may be disturbed by any of the planned renovation projects.

Other hazardous building materials (HBMs) identified during the survey are as follows:

Material	Location	Degree/Extent of Potential Impacts
Thermostats	Throughout both buildings	This material may be impacted through equipment replacement.
High voltage lighting	Garage	This material may be disturbed by any of the planned renovation projects.
Fluorescent light tubes	Throughout both buildings	This material may be disturbed by any of the planned renovation projects.
Fluorescent light ballasts	Throughout both buildings	This material may be disturbed by any of the planned renovation projects.

In Alberta, Class I facilities are authorized to accept hazardous waste. Operators of Class I facilities in Alberta include Tervita, Secure Energy Services, and SENA Waste Services to name a few.

This report should not be used alone for the purposes of tendering the removal and disposal of HBMs. We recommend that, prior to any abatement, a technical abatement specification be prepared consistent with the Canadian Master Specifications for abatement of the identified HBMs, and be included with the tender packages.

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1 Introduction

Associated Environmental Consultants Inc. (Associated), accompanied by Peak Environmental Ltd. (Peak), was retained by Parks Canada Agency (PCA) to complete a hazardous materials survey (HMS) at the Warden/Tech/Trades and the garage buildings in Banff, AB (the Subject Site) (Figure 1-1, Appendix A). PCA required a pre-renovation HMS as part of their due diligence practice to identify potential environmental and/or human health risks associated with certain hazardous materials at the Subject Site. These substances are asbestos-containing materials (ACMs), mercury, lead- or mercury-based paint, polychlorinated biphenyls (PCBs), and mould.

The objective of the HMS was to determine what hazardous materials occur at the two buildings in order to develop specifications and a construction cost estimate for hazardous materials abatement for the Banff Maintenance Compound (garage and Warden/Tech/Trades buildings) roof, HVAC, and boiler renovation projects. The interior and exterior of the buildings were completely assessed, but only areas relevant to the renovation projects require abatement specifications and construction management.

The scope of the HMS was to identify and confirm any and all types of hazardous materials that may be contained inside and outside the two buildings and to assess any risk to human health and safety. This HMS report serves as the first deliverable for the abatement project. Under separate cover will be specifications and construction estimates for the abatement of hazardous materials in the renovation areas.

2 Background

The Warden/Tech/Trades and garage buildings are located in the industrial area on the northeast side of Banff, AB.

- The Warden/Tech/Trades building was built in the 1970s. Exterior walls are constructed of brick. Interior outer walls are concrete block, and other interior walls are mainly drywall or concrete block construction. There are two boilers located on the main floor, which heat the building. The HVAC system runs throughout the basement and main floor. The interior ceiling is constructed with wood shiplap and steel structural support beams. The roof is flat with torch-on roofing.

- The garage was likely built in the 1950s. Exterior walls are coated with stucco. Interior walls are mainly block with some drywall. There is one boiler room with two boilers, which heat the building. The HVAC system runs throughout the building. The interior ceiling is constructed with wood shiplap and steel structural support beams. The two-level roof is flat with torch-on roofing.

Further information on building construction is provided in Appendix B (building inventory).

3 Regulations and Standards

Where applicable, Associated used the following reference documents and regulatory guidelines to complete the HMS.

3.1 FEDERAL AND PROVINCIAL OCCUPATIONAL HEALTH AND SAFETY REGULATIONS

Alberta Occupational Health & Safety is responsible for worker safety in Alberta workplaces. Responsibilities of the employer and employees as stated in the ***Occupational Health and Safety Act*** (R.S.A. Alberta 2000, c. O-2), Regulation and Code are to be maintained at all times. All surveying and sampling activities were carried out in accordance with all best practices and safety regulations to ensure worker and public health and safety.

3.2 ASBESTOS-CONTAINING MATERIAL

Asbestos is an inhalation hazard and is more of a safety hazard than a hazardous waste; however, due to special handling, precautions, and disposal required, asbestos is similar in nature to hazardous waste and must be dealt with accordingly. The Alberta Guidelines for the Disposal of Asbestos Waste defines “asbestos waste” as a waste containing asbestos with greater than 1% asbestos by weight (Alberta 1989). Asbestos may be found in the serpentine form (chrysotile) or as an amphibole (crocidolite, tremolite, amosite, anthophyllite, or actinolite).

The procedures for handling ACMs were carried out in accordance with the Alberta Asbestos Abatement Manual (Alberta 2012).

3.3 LEAD-BASED PAINT

Any substance that contains lead in a dispersible form, including paint, greater than 5 mg/L (5 ppm) is considered a hazardous substance under Alberta’s *Waste Control Regulation* (Alberta WCR 192/1996). Class I landfills can accept solid waste producing a waste extract (leachate) where the concentration of lead is less than 100 mg/L (100 ppm); Class II landfills are prohibited from accepting hazardous material as defined in the WCR. If lead-based paint (LBP) is removed from a surface by sand blasting, spent shot blasting waste is considered hazardous material as per the Alberta User Guide for Waste Managers.

3.4 MERCURY

The mercury vapour in fluorescent lights (e.g., compact fluorescent lamps, fluorescent lamps, fluorescent U-tubes, fluorometric lamps, linear fluorescent lamps, mercury vapour lamps, metal halide lamps and sodium vapour lamps) and in any other mercury-containing equipment (e.g., thermostats) can be a source of mercury leaching into the environment. Alberta currently follows the disposal criteria set out by the Canadian Council of Ministers of the Environment (CCME) in the Canada-Wide Standard for Mercury-Containing Lamps (CCME 2001). The standards state that any mercury-containing fixtures and equipment taken out of service must be disposed of in a registered waste facility.

3.5 POLYCHLORINATED BIPHENYLS

Polychlorinated biphenyls in ballasts and electrical components can be a dermal hazard and a source of PCBs leaching into soil. These materials must be transferred to a registered Class 1 landfill and disposed of according to federal government and Canadian Environmental Protection Agency (CEPA) regulations established in 1999 and expanded upon in the *PCB Regulations* in 2008, as well as Alberta's *Waste Control Regulations* and the separately published Waste Management Information for Businesses that Manage Hazardous Waste and Hazardous Recyclables (Alberta 2006).

In accordance with Environment Canada's report entitled Identification of Lamp Ballasts Containing PCBs (Report EPS 2/CC/2) (Environment Canada 1991), all identified fluorescent light ballasts are to be inspected and their manufacturing information compared against a listing of PCB-containing ballasts prior to disposal. As well, the Handbook on PCBs in Electrical Equipment (Environment Canada 1988) describes how to identify potential PCB-containing electrical transformers, and the hazards and appropriate handling for such equipment.

4 Methods

From September 21 to 23, 2016, Andrea Ellis, B.Sc., of Associated and Steve Ferguson, *Asbestos Hazard Emergency Response Act* (AHERA) Certified Building Inspector No. CABIR-12-018, of Peak conducted an intrusive (i.e., destructive) assessment to identify hazardous materials on the Subject Site. The survey included an assessment of architectural, mechanical, electrical, and civil construction systems. Renovation drawings (provided via email through Laurie MacDonald of PCA on September 29, 2016) were reviewed prior to the survey. A project start-up meeting, which included team members from PCA, Associated, and Peak, was conducted on site prior to the start of the survey.

The survey had some limitations, which are described in Section 5.7.

The following sections describe the health and safety precautions, sampling procedures, hazardous materials analysis procedures, and quality assurance / quality control (QA/QC) procedures that were followed during the HMS. Sampling locations are shown on the building floor plan (Appendix A). Photographs taken during the HMS are provided in Appendix C.

4.1 HEALTH AND SAFETY

Associated completed a Job Safety Plan prior to commencing the survey, which included the following information:

- hazard assessment and mitigative measures;
- project-specific personal protection equipment;
- safety training;
- location of the nearest medical facility; and
- emergency contact information.

A copy of the Health and Safety forms are included in Appendix D.

4.2 ASBESTOS-CONTAINING MATERIAL AND LEAD-BASED PAINT

The procedures for sampling and analyzing suspected ACMs and LBP were as follows:

- Each sample bag was labelled with a specific ID number, sample location, date, and type of material sampled. The information was recorded on a sampling data form.
- Each sample location was recorded on the floor plan and documented for project records.
- For ACM samples, a clean knife was used to cut out or scrape off a small piece of material. If the material was likely to become airborne, the area to be sampled was moistened with water prior to sampling.
- Paint samples were screened using a lead check swab (600 ppm detection limit) by first scraping the painted area with a knife to expose all layers of paint and then applying the swab to the untouched and scraped area.

- Each paint layer was removed down to substrate while minimizing disturbance of adjacent materials.
- For each sample type, the above steps were repeated at each sample location. Samples were double-bagged to minimize potential for particulate release.
- A laboratory chain of custody form was completed. The applicable test(s) for each sample was noted in the “analysis required” column.
- Samples were submitted to Total Safety in Burnaby, BC for analysis of asbestos
- Results returned from the lab were reviewed.

4.3 MERCURY IN PAINT

Mercury was used historically in paint as an anti-microbial pesticide to prevent mould growth. Mercury has not been added to paint in over ten years. Once the paint dries, the mercury is bound to the paint matrix and cannot be released (Health Canada 2004). It is possible that both the Warden/Tech/Trades and the garage buildings have mercury in paint. If so, the paint would have no health and safety problems for workers in the buildings. The paint does not require removal. Current renovation plans will not impact any painted areas.

4.4 OTHER MATERIALS

Other hazardous materials with the potential to contain mercury or PCBs were noted during the survey. Mould was also noted if observed.

4.5 QUALITY ASSURANCE / QUALITY CONTROL

A summary of the QA/QC procedures undertaken by the field staff, including the cleaning of sampling equipment, collecting samples and field duplicates, handling and management, is as follows:

- Sampling equipment was cleaned before sampling and between collections by washing the equipment in water and wiping with a wet paper towel or using disposable wipes.
- Samples submitted for laboratory analyses were identified on the outside of the laboratory-supplied sample bags and on the laboratory-supplied chain of custody form.

Total Safety carried out standardized laboratory QA/QC and provided a report of the results (Appendix C). Total Safety’s Quality Assurance Report revealed no issues. All data for the survey are considered acceptable.

5 Results

The results of the sampling and analysis of hazardous materials at the Warden/Tech/Trades and garage buildings are summarized below. The following documentation is attached to this report (as required in the Terms of Reference (PCA August 2016) for this project):

- Sampling locations (Drawings 3638 ASB 1-1, 1-2, and 2-2, Appendix A);
- Building inventory (Appendix B);
- Photographs of each site and sample location (Appendix C); and
- Detailed laboratory reports (Appendix E).

5.1 ASBESTOS-CONTAINING MATERIALS

The following interior and exterior materials were sampled at the Warden/Tech/Trades and garage buildings:

- Flooring
- Drywall tape compound
- Plaster
- Ceiling tile
- Window putty
- Cast iron bell and spigot joint/spigot packing
- Pipe flange gaskets
- Interior mastics and sealants (including HVAC high velocity duct joint sealant)
- Boiler exhaust vents
- Refractory cement on boiler segments
- Insulating cement on pipe fittings
- Fireproofing material
- Exterior putty and sealants
- Roof flashing tar
- Roofing
- Exterior stucco

Of the 82 samples submitted for ACM analysis, 17 samples contained detectable concentrations of asbestos or were assumed to contain asbestos based on professional experience (Tables 5-1 and 5-2). Four materials which were not able to be sampled at the time of the survey were suspected to contain asbestos.

Of the materials found or suspected to contain asbestos all but three are low risk of exposure to building occupants. Three materials, insulating cement on hot water pipe fitting, boiler exhaust breaching and drywall taping compound, found in section “B” of the Warden/Tech/Trades building are moderate or low-moderate risk of exposure to building occupants.

A room by room summary of ACM applications in each building is provided in Appendix B. As shown on the figure in Appendix B, yellow highlighting indicates asbestos applications and blue highlighting indicates suspect asbestos applications. Recommendations are summarized in Section 6.

Table 5-1
Identified asbestos-containing material in the Warden/Tech/Trades Building

Material	Sample Number/ Photo Reference	Location	Current Risk of Exposure	Quantity
Refractory cement on boiler segments	Photo 108	Boiler room A106	Low	1 m^2
Soft grey window putty, exterior windows	3638-19 Photo 24	“A” section of the building	Low	5 m^2
Cast iron bell and spigot joint packing	Photo 112	“A” section of the building	Low	Not quantified, located throughout building
Boiler exhaust “B” vent through ceiling (suspect)	Photo 109	Boiler room A106	Low	1
Beige insulating cement on hot water pipe fitting	3638-20, -24, -26 Photos 26, 30, 33	“B” section of the building	Moderate	225 elbows
Boiler exhaust breaching	3638-25 Photo 31	Boiler room B138	Moderate	28 m^2
12x12” tan floor tiles with minimal brown streaks	3638-13 Photo 17	“B” section of the building	Low	173 m^2
Various high velocity duct joint sealants	3638-15, -23, -28 Photos 20, 29, 36	“B” section of the building	Low	Not quantified, located throughout building
Soft grey exterior window putty	3638-22 Photo 28	“B” section of the building	Low	9 m^2

Material	Sample Number/ Photo Reference	Location	Current Risk of Exposure	Quantity
Beige drywall tape compound	3638-16, -21 Photos 21, 27	“B” section of the building	Low-Moderate	Not quantified, located throughout building
Various sealants and putties	3638-78, -79 Photos 91, 92	Roof	Low	Locations shown on drawings
Cast iron bell and spigot joint packing	Photo 112	“B” section of the building	Low	Not quantified, located throughout building
Pipe flange gasket	Photo 34	Boiler room B138	Low	50
Segmented cube boiler internal packing (suspect)	Photo 110	Boiler room B138	Low	

Table 5-2
Identified asbestos-containing material in the Garage

Material	Sample Number/ Photo Reference	Location	Current Risk of Exposure	Quantity
Beige and grey insulating cement on hot water and rainwater pipe fittings	3638-47, -51, -63, -65, -67 Photos 56, 60, 76, 78, 80	Throughout building	Low	225 elbows
12x12” tan floor tile with minimal brown streaks	3638-48 Photo 57	Lunch room 102	Low	54 m^2
Ceiling panel (suspect)	Photo 111	Lunch room 102, office 110, office 111	Low	20 m^2
Black on grey roof flashing tar	3638-70 Photo 83	Roof	Low	14 m^2
Cast iron sanitary and rainwater leader piping bell and spigot packing	Photo 112	Garage	Low	Not quantified, located throughout building
Pipe flange gasket	Photo 45	Boiler room 116	Low	2
Boiler refractory cement (suspect)	Photo 113	Boiler room 116	Low	2

5.2 LEAD-BASED PAINT

Each building contained painted interior and exterior surfaces. Of the 15 LBP samples screened on site, eight samples were above 600 mg/kg (Table 5-3).

Table 5-3
Identified lead-based paint

Material	Photo Reference	Location
An Associated Engineering Company Cream paint on exterior wood soffits	LBP-05 Photo 95	Warden/Tech/Trades - West exterior
Cream paint on white primer on wood ceiling ship lap	LBP-07 Photo 100	Warden/Tech/Trades - Vestibule A165
Red oxide primer on structural steel		Warden/Tech/Trades - Throughout “A” section of building
Cream paint on concrete block wall (original colour)	LBP-10 Photo 102	Warden/Tech/Trades - Stores A154
Red oxide primer under cream paint on structural steel	LBP-03 Photo 105	Garage - Storage 119
Cream paint on wood shiplap ceiling	LBP-02 Photo 104	Garage - Storage 119
Cream paint on concrete block wall	LBP-03 Photo 106	Garage - General workshop 122, north wall
White paint over cream paint on concrete block wall	LBP-04 Photo 107	Garage - General workshop 122, north wall

The following materials were screened for suspected LBP but did not contain lead concentrations above 600 ppm:

- Grey paint on concrete floor – Room A018 (LBP 01);
- White paint on concrete block wall – Room A018 (LBP 02, Photo 96);
- Cream paint on concrete floor – Office A019 (LBP 03, Photo 97);
- Light green paint on concrete column – Storage A006 (LBP 04, Photo 98);
- Cream paint on metal duct work – Locker Room A014 (LBP 06);

- Beige paint on concrete block wall – Stores A154 (LBP 09, Photo 101); and
- White paint on concrete block wall (top coat) – Stores A154 (LBP 11, Photo 103).

5.3 MERCURY

The following mercury-containing materials were noted during the survey:

- Mercury-containing wall mounted thermostats: there are 12 thermostats in the Warden/Tech/Trades building and 10 thermostats in the garage.
- Mercury-containing high voltage lighting: there is no high voltage lighting in the Warden/Tech/Trades building and 20 high voltage lights in the garage.
- Mercury-containing fluorescent light tubes: there are about 1,200 fluorescent light tubes in the Warden/Tech/Trades building and 300 fluorescent light tubes in the garage

5.4 POLYCHLORINATED BIPHENYLS

There are 500 fluorescent lights with ballasts in the Warden/Tech/Trades building and 150 fluorescent lights with ballasts in the garage.

5.5 MOULD

Associated did not observe any mould in either of the buildings.

5.6 SURVEY LIMITATIONS

The HMS was subject to Associated's standard disclaimer (attached). While the goal of the HMS was to identify all potentially hazardous substances in the two buildings, as noted above, the sampling program had limitations: limited time was available for on-site sampling, and some designated substances were, by nature, concealed.

6 Conclusions and Recommendations

Associated and Peak conducted a HMS at the Warden/Tech/Trades and the garage buildings in Banff from September 21 to 23, 2016. The surveys investigated the presence/absence of the following hazardous materials: ACMs, LBP, PCBs, mercury, and mould.

The findings of the HMS indicate that the Subject Site contains the following hazardous materials:

- ACM confirmed at 17 locations
- ACM suspected at four locations;
- Lead-based paint confirmed for eight samples containing lead concentrations above 600 mg/kg;
- Mercury-containing materials (thermostats, high voltage lighting, and fluorescent light tubes); and
- Potential PCB-containing materials (fluorescent light ballasts).

None of the hazardous materials identified during the HMS pose a health or safety risk to the occupants of the building. These hazardous materials and associated potential impacts of these materials are summarized in Tables 6-1, 6-2, and 6-3.

Table 6-1
Summary of asbestos-containing materials found during the survey

Material	Location	Quantity	Degree/Extent of Potential Impacts During Renovation Activities
Refractory cement on boiler segments	Boiler room A106	1 m^2	This material will be disturbed by the boiler renovation project. The existing boiler is to be removed.
Soft, grey, exterior window putty	“A” section of the building	5 m^2	This material may be disturbed by any of the planned renovation projects.
Putty and sealants	Roof		This material may be affected by the roof renovation project.
Cast iron bell and spigot joint packing	“A” section of the building		This material may be disturbed by any of the planned renovation projects.
Boiler exhaust “B” vent through ceiling (suspect)	Boiler room A106		This material will be disturbed by the boiler renovation project. The flue vent connection from boiler will be removed. Inspection for asbestos insulation must be performed once the boiler is off and prior to demolition work.
Beige insulating cement on hot water pipe fitting	“B” section of the building	225 elbows	This material may be disturbed by the planned renovation projects.
Boiler exhaust breaching	Boiler room B138	28 m^2	This material will be disturbed by the boiler renovation project.
12x12” tan floor tiles with minimal brown streaks	“B” section of the building		This material may be disturbed by any of the planned renovation projects.
Various high velocity duct joint sealants	“B” section of the building		This material will be disturbed by the HVAC renovation project.
Soft grey exterior window putty	“B” section of the building	9 m^2	This material may be disturbed by any of the planned renovation projects.
Beige drywall tape compound	“B” section of the building		This material may be disturbed in areas where demolition is necessary to facilitate work.

Material	Location	Quantity	Degree/Extent of Potential Impacts During Renovation Activities
Various sealants and putties	Roof		This material will be affected by the roof renovation project.
Cast iron bell and spigot joint packing	“B” section of the building		This material may be disturbed by any of the planned renovation projects.
Segmented cube boiler internal packing (suspect)	Boiler room B138		This material will be disturbed by the boiler renovation project. The existing boiler is to be removed.
Beige and grey insulating cement on hot water and rainwater pipe fittings	Garage corridor - 101	4 elbows	This material will be disturbed by any of the planned renovation projects.
12x12” tan floor tile with minimal brown streaks	Garage lunch room - 102	54 m^2	This material may be disturbed by any of the planned renovation projects.
Ceiling panel (suspect)	Garage lunch room 102, office 110, office 111		This material may be disturbed by any of the planned renovation projects.
Black on grey roof flashing tar	Roof	14 m^2	This material will be affected by the roof renovation project.
Cast iron sanitary and rain water leader piping bell and spigot packing	Garage		This material may be disturbed by any of the planned renovation projects.
Pipe flange gasket	Garage boiler room - 116	2	This material will be affected by the boiler room renovation project.
Boiler refractory cement (suspect)	Garage boiler room - 116		This material will be affected by the boiler room renovation project. Inspection for asbestos insulation must be performed once the boiler is off and prior to demolition work.

Table 6-2
Summary of lead-based paint >600 ppm found during the survey

Material	Location	Degree/Extent of Potential Impacts
Cream paint on exterior wood soffits	West exterior	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Cream paint on white primer on wood ceiling shiplap	Vestibule A165	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Red oxide primer on structural steel	Throughout “A” section of building	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Cream paint on concrete block wall (original colour)	Stores A154	This material may be disturbed by any of the planned renovation projects.
Cream paint on exterior wood soffits	West exterior	This material may be disturbed by any of the planned renovation projects.
Red oxide primer on structural steel	Throughout “B” section of building	This material may be disturbed by any of the planned renovation projects.
Red oxide primer under cream paint on structural steel	Garage - Storage 119	This material may be disturbed by any of the planned renovation projects.
Cream paint on wood shiplap ceiling	Garage - Storage 119	This material may be impacted in areas where cutting through existing finishes is required to facilitate new work.
Cream paint on concrete block wall	General workshop 122, north wall	This material may be disturbed by any of the planned renovation projects.
White paint over cream paint on concrete block wall	General workshop 122, north wall	This material may be disturbed by any of the planned renovation projects.

Table 6-3
Summary of other hazardous building materials found during the survey

Material	Location	Quantity	Degree/Extent of Potential Impacts
Thermostats	Throughout both buildings	22	This material may be impacted through equipment replacement.
High voltage lighting	Garage	20	This material may be disturbed by any of the planned renovation projects.
Fluorescent light tubes	Throughout both buildings	1,500	This material may be disturbed by any of the planned renovation projects.
Fluorescent light ballasts	Throughout both buildings	650	This material may be disturbed by any of the planned renovation projects.

6.1 WASTE STREAM MANAGEMENT

Considering the multiple findings of hazardous materials during the HMS, Associated recommends that any waste produced from abatement or deconstruction be segregated into material-specific waste streams. The reasons for this recommendation are as follows:

- If mixed with other material, a small amount of a hazardous substance can make a large volume of non-hazardous material hazardous.
- Generally, hazardous wastes are significantly more expensive to handle and dispose of than non-hazardous wastes.
- Solid and liquid wastes are not to be mixed. Landfills will not accept liquid-saturated waste.

We recommend that waste be categorized at three levels to minimize disposal costs:

1) **Primary** – Separate industrial (both hazardous and non-hazardous) waste materials from domestic or municipal refuse.
2) **Secondary** – Categorize industrial waste materials as hazardous or non-hazardous. Store all hazardous wastes as per Alberta regulations.
3) **Tertiary** – Some types of hazardous wastes must be stored and disposed of separate from other hazardous wastes.

6.2 HAZARDOUS MATERIALS

None of the hazardous materials (e.g., ACM, LBP, mercury and PCBs) identified during the HMS pose immediate threat to human health and safety in their current state, and none require immediate action. Prior to any future building renovations, modifications, construction, or demolition, these substances should be managed in accordance with applicable regulations to limit potential exposure during their disturbance.

Further, a copy of this report should be used as a designated substance management guide to be consulted during the planning of future building renovations, modifications, construction, or demolition.

If alteration painted surfaces which were identified as containing lead is required, the paint will need to be removed prior to modification by means of mechanical or chemical treatment to the paint. The removed paint must be treated as hazardous waste and disposed of at a registered waste facility. Alternatively, the paint may remain in place in an unaltered state as there is no immediate risk to human health.

Hazardous materials do not require disposal based solely on the reason that they contain hazardous constituents. Some substances can be recycled at the end of their life cycle or if taken out of service. For example, there are recycling programs that accept fluorescent light bulbs. The thermostats do not require disposal if they are to remain in use.

References

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Occupational Health and Safety Act, R.S.A. Alberta 2000, c. O-2.

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Parks Canada Agency (PCA). Terms of Reference. Parks Canada Banff Operations Compound Garage Building and Warden/Tech/Trades Building. Banff, Alberta. August 2016.

Waste Control Regulation, Alberta Regulation 192/1996, including amendments 62/2013.

Disclaimer

ASSOCIATED ENVIRONMENTAL CONSULTANTS INC.

STANDARD DISCLAIMER FOR CONTAMINATED SITE INVESTIGATIONS, MONITORING, CONFIRMATION OF REMEDIATION SERVICES AND HAZARDOUS BUILDING MATERIAL ASSESSMENTS

Subject to the following conditions and limitations, the investigation described in this report has been conducted by Associated Environmental Consultants Inc. (ASSOCIATED) for **Parks Canada Agency** (the CLIENT) in a manner consistent with a reasonable level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area.

1. The scope of the investigation described in this report has been limited by the budget set for the investigation in the work program. The scope of the investigation has been reasonable having regard to that budget constraint.
2. The investigation described in this report has been limited to the scope of work described in the work program.
3. The investigation described in this report has relied upon information provided by third parties concerning the history of the site. Except as stated in this report, we have not made an independent verification of such historical information.
4. The investigation described in this report has been made in the context of existing government regulations generally promulgated at the date of this report. Except as specifically noted, the investigation did not take account of any government regulations not in effect and generally promulgated at the date of this report.
5. The findings and conclusions are valid only for the specific site identified in the report.
6. Since site conditions may change over time, the report is intended for immediate use.

This report is intended for the exclusive use of the CLIENT, including all successors and assigns. The material in it reflects ASSOCIATED's best judgement, in light of the information available to it, at the time of preparation. Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ASSOCIATED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report and makes no representation of fact or opinion of any nature whatsoever to any person or entity other than the CLIENT.

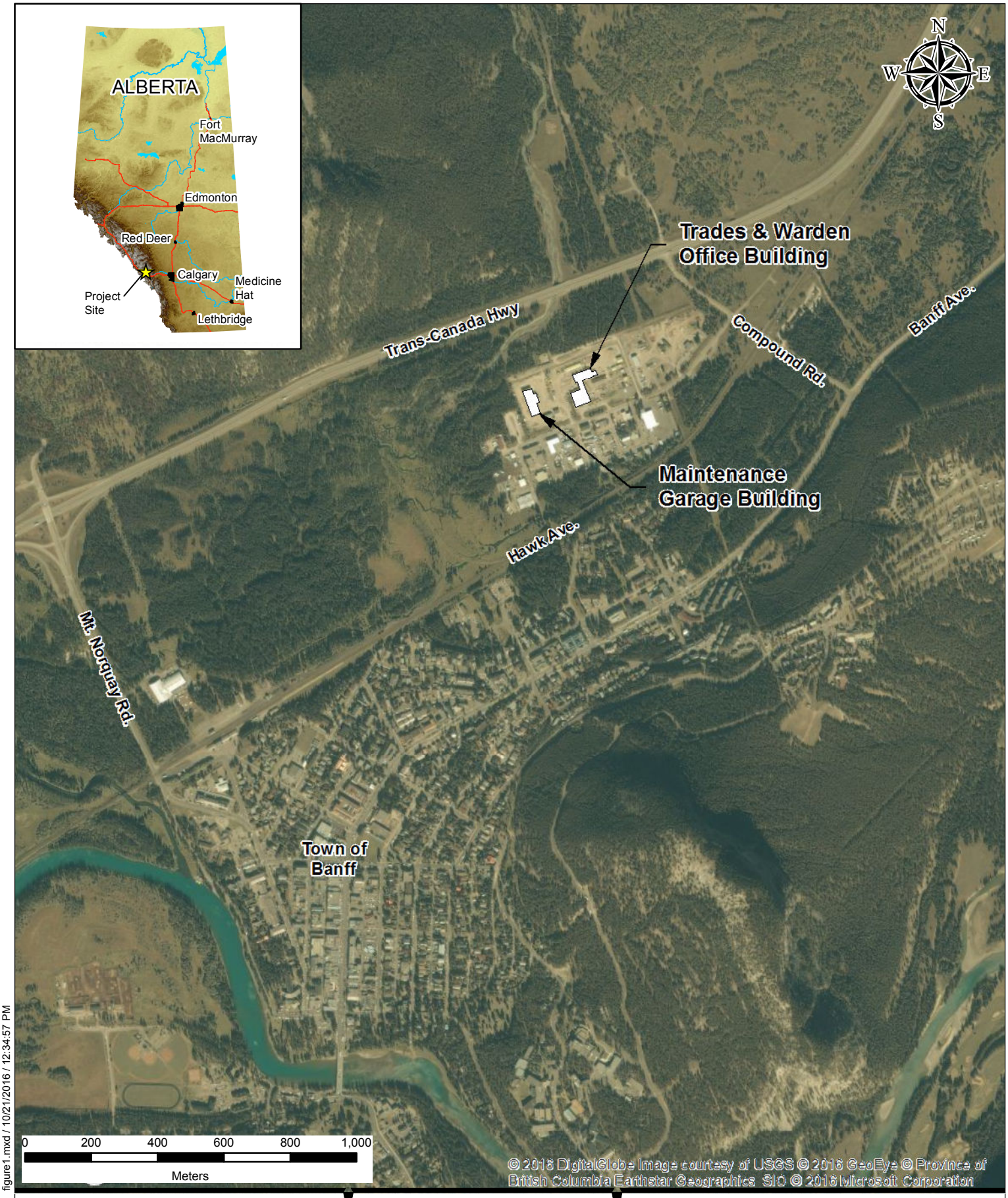
In accepting delivery of this report, the CLIENT hereby agrees that:

1. ASSOCIATED's liability for all claims of the CLIENT, arising out of the agreement between ASSOCIATED and the CLIENT, pursuant to which this report has been prepared (the Agreement) shall absolutely cease to exist after a period of six (6) years from the date of:
   a) substantial completion of the investigation described in this report,
   b) termination of ASSOCIATED's services under the Agreement,
   c) commencement of the limitation period for claims prescribed by any statute of the Province or Territory for the site of the investigation described in this report,
   d) any significant alteration of the site of the investigation described in this report, and/or neighbouring properties after the date of the final report that would change the conclusions and recommendations of the final report,

whichever shall first occur, and following the expiration of such period, the CLIENT shall have no claim whatsoever against ASSOCIATED.

2. Any and all claims that it may have against ASSOCIATED or any of its servants, agents, or employees arising out of or in any way connected with the investigation described in this report or the preparation of this report, whether such claims are in contract or in tort, and whether such claims are based on negligence or otherwise, shall be limited to a total amount equal to the fees payable to ASSOCIATED under the contract with the CLIENT. ASSOCIATED shall bear no liability whatsoever for any consequential loss, injury or damage incurred by the CLIENT including but not limited to claims for loss of profits and loss of markets.

Appendix A – Figures



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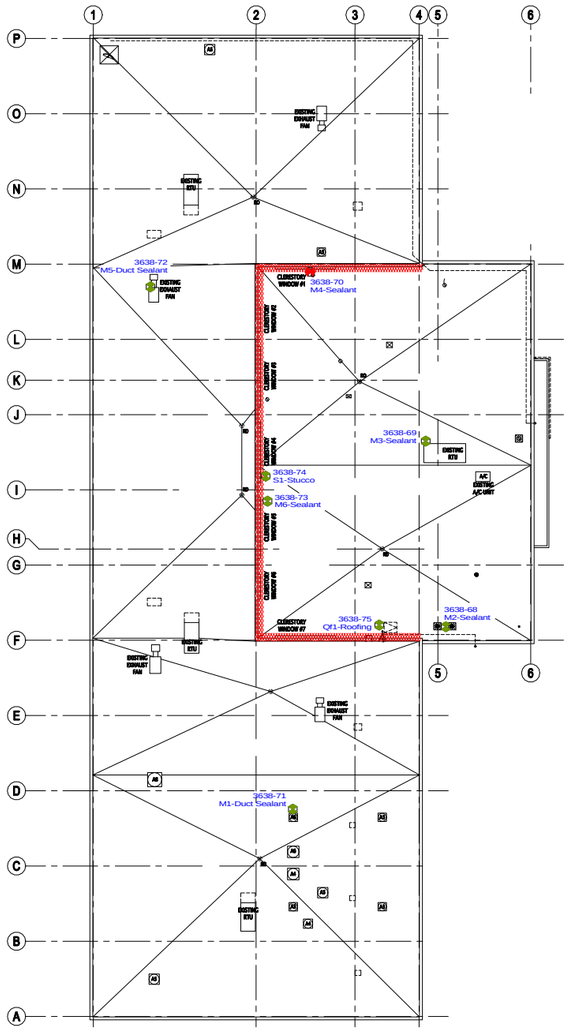
Associated Environmental

PROJECT NO.: 2016-3790.100.040
DATE: October 2016
DRAWN BY: BdJ

FIGURE 1-1: PROJECT LOCATION

Parks Canada Agency

Parks Canada Agency Banff Operations Compound



ROOF DEMOLITION PLAN

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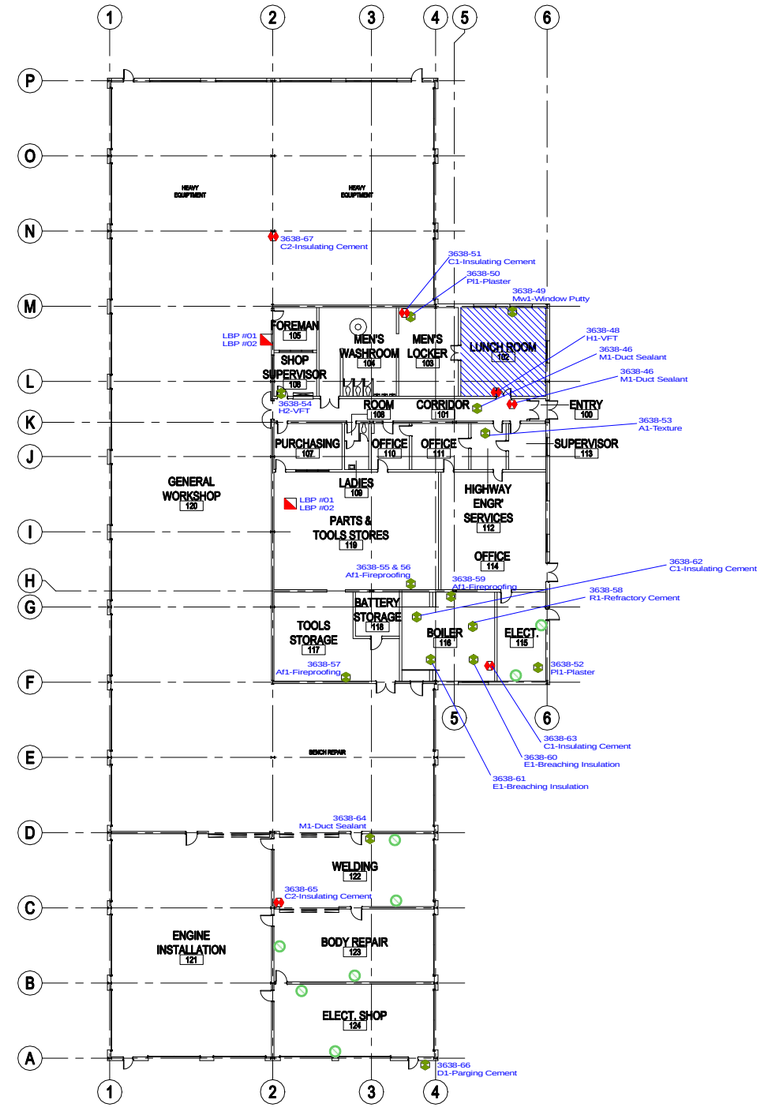

EXISTING FLOOR PLAN

SCALE: SCALE: 1:200

GENERAL NOTES - ASBESTOS CONTAINING MATERIALS

- ALL INSULATED PIPE FITTINGS ARE ASBESTOS CONTAINING
- ALL CAST IRON SANITARY BELL AND SPIGOT JOINT PACKING IS ASBESTOS CONTAINING
- PIPE FLANGE GASKETS ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS

GENERAL NOTES - LEAD BASED PAINT

- RED OXIDE PRIMER ON STRUCTURAL STEEL CONTAINS LEAD
- CREAM AND WHITE PAINT ON WOOD AND CONCRETE CONTAINS LEAD

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info@peakenvironmental.ca

Project No.: 3638

Drawing:

Banff National Park
Banff, Alberta

PCA - MAINTENANCE COMPOUND

GARAGE BUILDING
MAIN FLOOR AND
ROOF PLAN

Title:

ASBESTOS AND LEAD CONTAINING MATERIALS AND SAMPLE LOCATIONS

Owner:

Parks Canada | Parcs Canada

Western and Northern Region | Quest et Nord du Canada

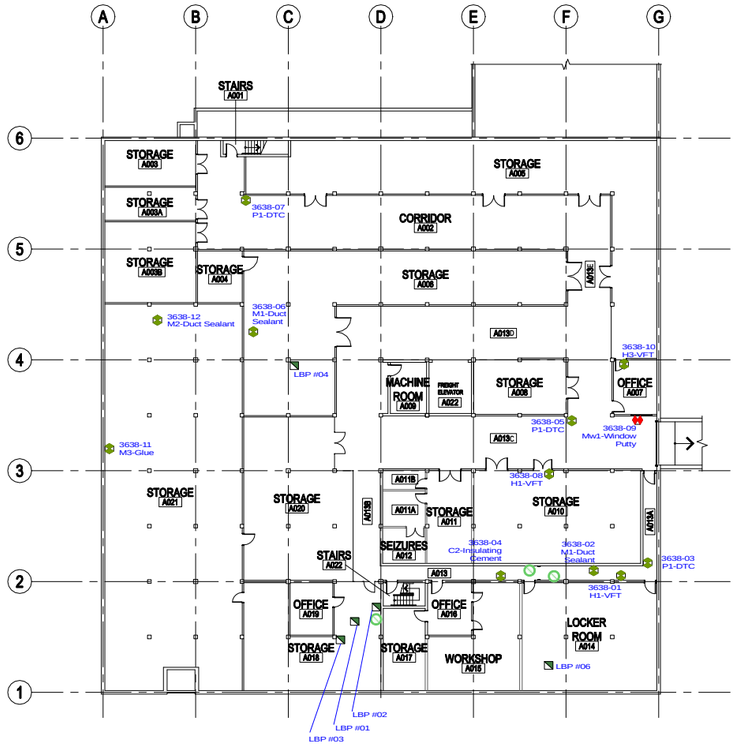
Legend:

- ASBESTOS FLOOR TILE
- ASBESTOS FLASHING TAR
- LEAD BASED PAINT SAMPLE POSITIVE
- LEAD BASED PAINT SAMPLE NO LEAD DETECTED
- BORE HOLE LOCATION WITH NO VERMICULITE
- ASBESTOS BULK SAMPLE NUMBER AND MATERIAL
- NON-ASBESTOS BULK SAMPLE NUMBER AND MATERIAL

Date: 10.20.2016
Revision:
Scale: 1 : 200
Drawn by: S.Ferguson

DRAWING NUMBER

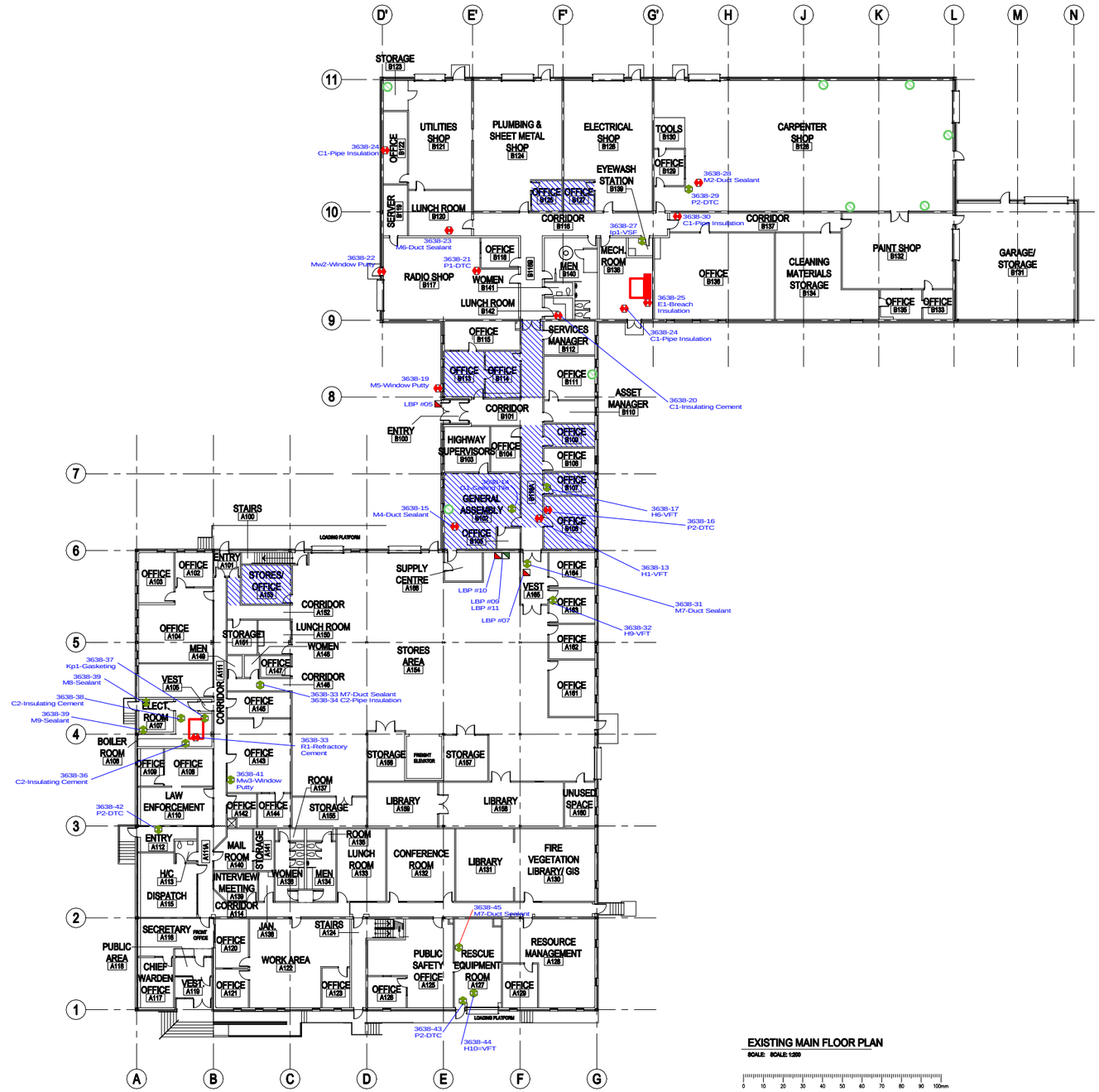
3638 ASB 1-1



PROJECT NORTH

EXISTING BASEMENT PLAN

SCALE: 1:200



EXISTING MAIN FLOOR PLAN

SCALE: SCALE 1:200

0 10 20 30 40 50 60 70 80 90 100mm

GENERAL NOTES - ASBESTOS CONTAINING MATERIALS

- ALL INSULATED PIPE FITTINGS ARE ASBESTOS CONTAINING IN ROOMS WITH HAVING A 'B' DESIGNATION
- ASBESTOS CONTAINING DRYWALL TAPE COMPOUND IS LIMITED TO ROOMS WITH HAVING A 'B' DESIGNATION
- ALL GREY WINDOW PUTTIES ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS
- ALL CAST IRON SANITARY BELL AND SPIGOT JOINT PACKING IS ASBESTOS CONTAINING
- PIPE FLANGE GASKETS ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS
- ALL GREY AND GOLD COLOUR DUCT JOINT SEALANTS ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS

GENERAL NOTES - LEAD BASED PAINT

- RED OXIDE PRIMER ON STRUCTURAL STEEL CONTAINS LEAD
- CREAM PAINT ON EXTERIOR WOOD SOFFITING CONTAINS LEAD
- CREAM ON WHITE PRIMER ON SHIPLAP INTERIOR CEILINGS CONTAINS LEAD
- CREAM ON INTERIOR CONCRETE BLOCK WALLS CONTAINS LEAD

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Project No.: 3638

Drawing:
Banff National Park
Banff, Alberta

PCA - MAINTENANCE COMPOUND

TRADES & WARDEN OFFICE BUILDING BASEMENT AND MAIN FLOOR PLAN

Title:
ASBESTOS AND LEAD CONTAINING MATERIALS AND SAMPLE LOCATIONS

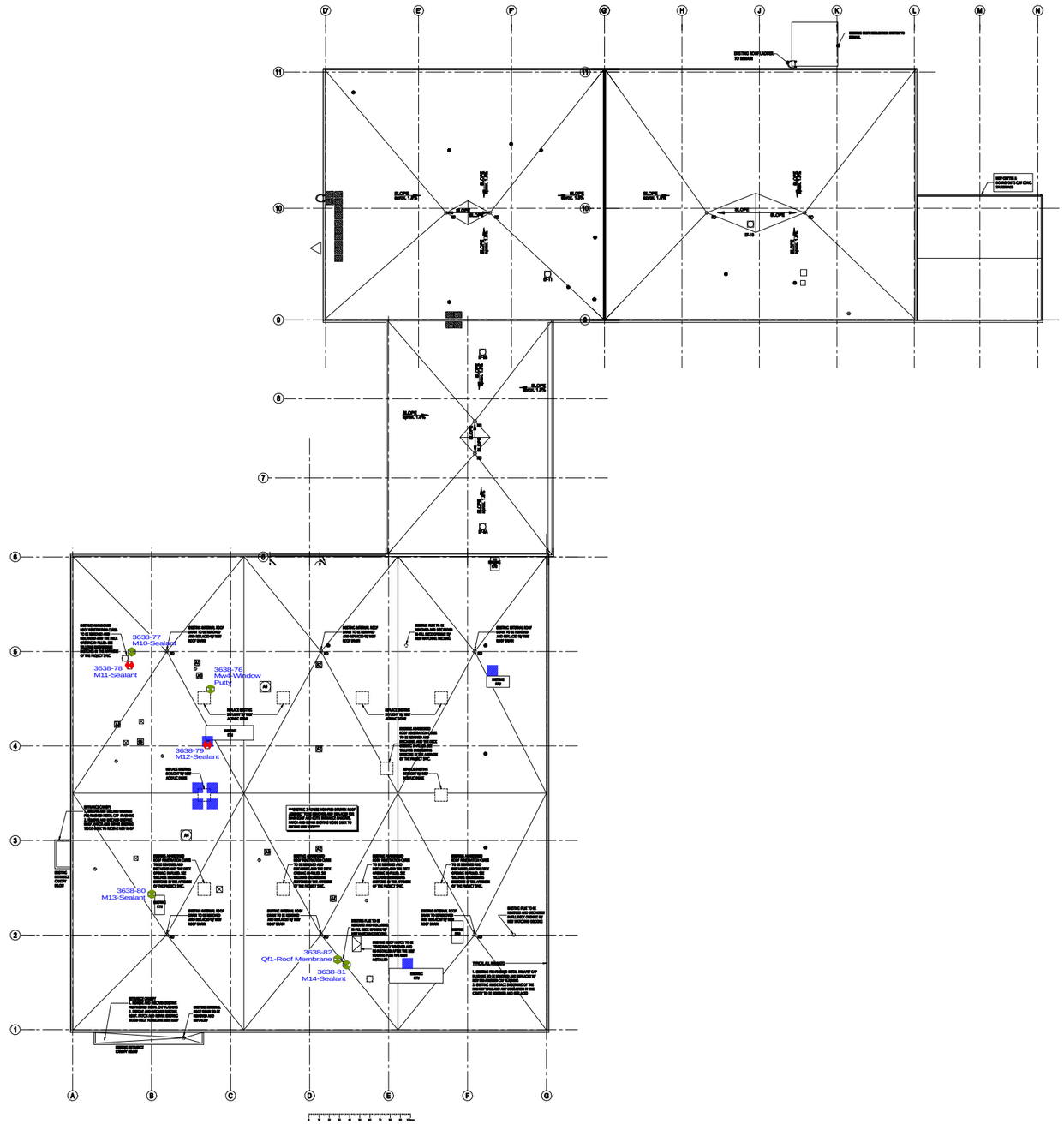
Owner:
Parks Canada / Parcs Canada
Western and Northern Region / Quest et Nord du Canada

Legend:

- BOILER BREACHING INSULATION
- BOILER PACKING INSULATION
- EXPOSED ASBESTOS FLOORING
- LEAD BASED PAINT SAMPLE POSITIVE
- LEAD BASED PAINT SAMPLE NO LEAD DETECTED
- BORE HOLE LOCATION WITH NO VERMICULITE
- ASBESTOS BULK SAMPLE NUMBER AND MATERIAL
- NON-ASBESTOS BULK SAMPLE NUMBER AND MATERIAL

Date: 10.12.2016
Revision:
Scale: 1 : 200
Drawn by: S.Ferguson

DRAWING NUMBER
3638 ASB 1-2



GENERAL NOTES - ASBESTOS CONTAINING MATERIALS

- ALL INSULATED PIPE FITTINGS ARE ASBESTOS CONTAINING IN ROOMS WITH HAVING A 'B' DESIGNATION
- ASBESTOS CONTAINING DRYWALL TAPE COMPOUND IS LIMITED TO ROOMS WITH HAVING A 'B' DESIGNATION
- ALL GREY WINDOW PUTTIES ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS
- ALL CAST IRON SANITARY BELL AND SPIGOT JOINT PACKING IS ASBESTOS CONTAINING
- PIPE FLANGE GASKETS ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS
- ALL GREY AND GOLD COLOUR DUCT JOINT SEALANTS ARE TO BE CONSIDERED ASBESTOS CONTAINING UNLESS CONFIRMED OTHERWISE THROUGH BULK SAMPLE ANALYSIS

GENERAL NOTES - LEAD BASED PAINT

- RED OXIDE PRIMER ON STRUCTURAL STEEL CONTAINS LEAD
- CREAM PAINT ON EXTERIOR WOOD SOFFITING CONTAINS LEAD
- CREAM ON WHITE PRIMER ON SHIPLAP INTERIOR CEILINGS CONTAINS LEAD
- CREAM ON INTERIOR CONCRETE BLOCK WALLS CONTAINS LEAD

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info@peakenvironmental.ca

Project No.: 3638

Drawing:

Banff National Park
Banff, Alberta

PCA - MAINTENANCE COMPOUND

TRADES & WARDEN OFFICE BUILDING ROOF PLAN

Title:

ASBESTOS AND LEAD CONTAINING MATERIALS AND SAMPLE LOCATIONS

Owner:

Parks Canada / Parcs Canada
Western and Northern Region / Quest et Nord du Canada

Legend:

- ASBESTOS ROOF SEALANT/ PATCHES
- ASBESTOS BULK SAMPLE NUMBER AND MATERIAL
- NON-ASBESTOS BULK SAMPLE NUMBER AND MATERIAL

Date: 10.12.2016
Revision:
Scale: 1 : 200
Drawn by: S.Ferguson

DRAWING NUMBER
3638 ASB 2-2

Appendix B - Building Inventory

ROOM BY ROOM INVENTORY

Building Name: Parks Canada Banff Tech/Warden Building Date: 09/23/2016 (mm/dd/\yyyy) ANCILLARY INFORMATION

TB-Tack Board / GWB-Gypsum Wall Board / BW-Brick Wall / CBW-Concrete Block Wall / Car-Carpet / Conc-Concrete / STR-Structure / WD-Wood / FRP-fibreglass reinforced plastic

All applications are below accessible below 8 foot height unless otherwise noted as (h)-high for applications above 8' or as being (at)-Application concealed above T-bar ceilings /

(*) - assumed applications room not accessible / (af)-concealed above fixed ceilings / (uc)-concealed beneath carpeting / (uv)-concealed beneath vinyl sheeting / (ul)-concealed beneath laminate flooring

Application quantities are shown in Brackets (50) - All applications are in good condition unless noted as ... (p) poor or (f) fair

Only know or visually site confirmed asbestos applications are noted on these Ancillary Pages. Additional asbestos applications may be present within the rooms listed herein, but not shown on this spreadsheet.

Yellow highlighting indicates asbestos applications

BLUE highlighting indicates suspect asbestos application

A - Texture Coating	D - Cement Parging	***BUILDING MATERIAL IDENTIFICATION CODES***		K - Equipment Gasketing	N - Pipe Roving/Packing	Qs - Roofing Shingle	U - Friction Materials
Ac - Acoustic Insulation	E - Exhaust Breeching	G - Ceiling Panel	J - Cement Board	Kp - Pipe Gasketing	O - Floor Levelling Cement	R - Refractory Cement	V - Vermiculite Wall
Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	H - Vinyl Floor Tile	Jf - Asbestos Furnishings	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	I - Vinyl Sheet Flooring	Jp - Cement Pipe	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Third Ceiling	Mech. Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
	BASEMENT														
	Throughout Applications										N1				
A001	Stairwell	Conc		Conc/CBW	CBW	Conc/CBW	CBW	Conc							
A002	Corridor	Conc		P1	P1	P1	P!	Conc							
A003	Storage	Conc		Conc	Str	Str	Conc	Conc							
A003A	Storage	Conc		GWB	Str	Str	Conc	Conc							
A003B	Storage	Conc		GWB	Str	Str	Conc	Conc							
A004	Storage	Conc		Str	Str	Str	Str	Conc					M1		
A005	Storage	Conc		Conc	Conc	Wd		Conc			B1				
A007	Office	H3		P1	P1	P1	P1	G1	Conc						
A008	Storage	Conc		Str	Str	Str	CBW	Conc							
A009	Mechanical Room	Conc		CBW	CBW	CBW	CBW	Conc							
A009	Storage	Conc		Str	Str	Str	Str	Conc					M1		
A010	Office	Conc		P1	P1/CBW	P1	P1/Str	Conc							
A011	Storage	H1		P1	P1	CBW	P1	Conc							
A011A	Storage	H1		P1	P1	P1	P1	Conc							
A011B	Storage	H1		P1	P1	P1	P1	Conc							
A012	Seizures	H1		P1	P1	CBW	P1	Conc							
A013	Corridor	H1(f)		P1	-	CBW		Conc			B1	C2(8)	M1		

ROOM BY ROOM INVENTORY

Building Name: Parks Canada Banff Tech/Warden Building Date: 09/23/2016 (mm/dd/\yyyy) ANCILLARY INFORMATION

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BUILDING MATERIAL IDENTIFICATION CODES						
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Ac - Acoustic Insulation	E - Exhaust Breeching	H - Vinyl Floor Tile	Jf - Asbestos Furnishings	Kp - Pipe Gasketing	O - Floor Levelling Cement	R - Refractory Cement	V - Vermiculite Wall
Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	I - Vinyl Sheet Flooring	Jp - Cement Pipe	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot			Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Third Ceiling	Mech. Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
A013A	Corridor	H1(f)		P1	Conc	-	P1	Conc							
A013B	Corridor	Conc		P1/CBW	Wd	Str	-	Conc			N1				
A013C	Corridor	Conc		P1/CBW	P1	P1	-	Conc						Mw1(1)	
A013D	Corridor	Conc		P1	-	Str	Str/CBW	Conc							
A013E	Corridor	Coinc		-	P1/Str	-	P1/Str								
A014	Locker Room	Conc		CBW	Conc	Conc	CBW	Conc			B1	C2(25)	M1		
A015	Work Room	Conc		Str	CBW	Conc	CBW	Conc			B1	C2(14)	M1		
A016	Storage	Conc		CBW	P1	Wd	CBW	Conc			B1	C2(25)	M1		
A017	Storage	Conc		CBW	CBW	Conc	CBW	Conc			B1	C2(8)			
A018	Work Shop	Conc		Wd	CBW/Wd	Conc	Str./P1/Wd	Conc			B1	C2(30)			
A019	Office	Laminate	Conc	P1	P1	P1	P1	Conc							
A020	Storage	Conc		P1	Str	P1	P1	Conc			B1		M1		
A021	Storage	Conc/Dirt		P1	P1	Conc/M3	Conc/M3	Conc			N1		M2	M3	
A022	Stairwell	H1(f)		CBW	CBW	CBW	CBW	Conc/Metal			B1	C2(6)			
A022	Elevator Shaft	Conc		CBW	CBW	CBW	CBW	P1							
	MAIN FLOOR														
	Exterior			BW	BW	BW	BW							M5	
	Throughout Applications												M2,4,5,6,11 & 12	Mw1 & 2	
A101	Vestibule	Conc		P1	P1	P1	P1	P1							

ROOM BY ROOM INVENTORY

Building Name: Parks Canada Banff Tech/Warden Building Date: 09/23/2016 (mm/dd/\yyyy) ANCILLARY INFORMATION

TB-Tack Board / GWB-Gypsum Wall Board / BW-Brick Wall / CBW-Concrete Block Wall / Car-Carpet / Conc-Concrete / STR-Structure / WD-Wood / FRP-fibreglass reinforced plastic
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BUILDING MATERIAL IDENTIFICATION CODES						
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Ac - Acoustic Insulation	E - Exhaust Breeching	H - Vinyl Floor Tile	Jf - Asbestos Furnishings	Kp - Pipe Gasketing	O - Floor Levelling Cement	R - Refractory Cement	V - Vermiculite Wall
Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	I - Vinyl Sheet Flooring	Jp - Cement Pipe	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot			Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Third Ceiling	Mech. Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
A102	Office	Carpet	Conc	P1	P1	P1	P1	G5	Wd		B1(at)	C2(6at)	M7(at)		
A103	Office	Carpet	Conc	P1	P1	P1	P1	G5	Wd		B1(at)	C2(6at)	M7(at)		
A104	Office	Carpet	Conc	P1	P1	P1	P1	G5	Wd		B1(at)	C2(20at)	M7(at)		
A105	Vestibule	Conc		CBW	CBW	P1	P1	P1							
A106	Boiler Room	Conc		CBW	CBW/P1	CBW	P1	Conc			B1	C2(40)/ Kp1/Kp2	K1/R1(1)	E3	
A107	Electrical Room	Conc		CBW	P1	P1	CBW	Conc			B1			Mw1(1)/ M8(1)/M9(1)	
A108	Office	Rubber Tile		P1	P1	P1	P1	G3/G5	Wd				M7(at)	Mw3(3)	
A109	Office	Rubber Tile		P1	P1	P1	P1	G3/G5	Wd		B1(at)	C2(6at)	M7(at)		
A110	Office	Rubber Tile		P1	P1	P1	P1	G3/G5	Wd		B1(at)	C2(6at)	M7(at)		
A111	Corridor	Rubber Tile		P1	P1	P1	P1	G5					M7(at)		
A111A	Corridor	Rubber Tile		P1	P1	P1	P1	G5	LBP Wd				M7(at)		
A112	Entry	Rubber Tile		P1	P1	P1	P1	P1							
A113	Washroom	Rubber Tile		P1	P1	P1	P1	P1							
A114	Corridor	Rubber Tile		P1	P1	P1	P1	G3	LBP Wd		B1(at)	C2(16at)	M7(at)	Mw3(-)	
A114A	Corridor	Rubber Tile		P1	P1	P1	P1	P1							
A115	Dispatch	Carpet	Conc	P1	P1	P1	P1	G3/G5	Wd		B1(at)	C2(6at)	M7(at)	Mw3(6)	
A116	Reception	I2		P1	P1	P1	P1	G3/G5	Wd		B1(at)	C2(6at)	M7(at)	Mw3(8)	
A117	Office	I2		P1	P1	P1	P1	G3/G5	Wd				M7(at)		
A118	Vestibule	I2		P1	P1	P1	P1	P1							

ROOM BY ROOM INVENTORY

Building Name: Parks Canada Banff Tech/Warden Building Date: 09/23/2016 (mm/dd/\yyyy) ANCILLARY INFORMATION

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Ac - Acoustic Insulation	E - Exhaust Breeching	G - Ceiling Panel	J - Cement Board	Kp - Pipe Gasketing	O - Floor Levelling Cement	R - Refractory Cement	V - Vermiculite Wall
Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	H -Vinyl Floor Tile	Jf - Asbestos Furnishings	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	I - Vinyl Sheet Flooring	Jp - Cement Pipe	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Third Ceiling	Mech. Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
A119	Vestibule	I2		P1	P1	P1	P1	P1							
A120	Office	I2	Conc	P1	P1	P1	P1	G5	LPB Wd		B1(at)	C2(2at)	M7(at)		
A121	Office	Carpet	Conc	P1	P1	P1	P1	G5	LPB Wd		B1(at)	C2(2at)	M7(at)		
A122	Work Room	Carpet	Conc	P1	P1/GWB	P1/GWB	P1	G5	LPB Wd		B1(at)	C2(2at)	M7(at)		
A123	Office	Carpet	Conc	GWB	P1	P1	GWB	G5	LPB Wd		B1(at)	C2(2at)	M7(at)		
A124		NO ACCESS													
A125	Office	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(6at)	M7(at)		
A126	Office	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(2at)	M7(at)	Mw3(5)	
A127	Storage	H10/Conc		P1	P1	P1	P1	LBP Wd			B1	C2(10)	M7	Mw3(1)	
A128	Office	Carpet		P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(10at)	M7(at)		
A129	Office	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(2at)	M7(at)		
A130	Office	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(2at)	M7(at)	Mw3(4)	
A131	Office	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(2at)	M7(at)		
A132	Conference Room	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(2at)	M7(at)	Mw3(8)	
A133	Lunch Room	Rubber Tile		P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(2at)	M4(at)	Mw3(3)	
A134	Washroom	Ceramic		Ceramic on P1	Ceramic on P1	Ceramic on P1	Ceramic on P1	P1							
A135	Shower Room	Ceramic		Ceramic on P1	Ceramic on P1	Ceramic on P1	Ceramic on P1	P1							
A136	Washroom	Ceramic		Ceramic on P1	Ceramic on P1	Ceramic on P1	Ceramic on P1	P1							
A137	Shower Room	Ceramic		Ceramic on P1	Ceramic on P1	Ceramic on P1	Ceramic on P1	P1							

ROOM BY ROOM INVENTORY

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Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	H -Vinyl Floor Tile	Jf - Asbestos Furnishings	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	I - Vinyl Sheet Flooring	Jp - Cement Pipe	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Third Ceiling	Mech. Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
A138	Custodial	Rubber Tile		P1	P1	P1	P1								
A139	Office	Carpet	Conc	P1	P1	P1	P1	G3	LBP Wd				M7(at)		
A140	Mail Room	Carpet	Conc	P1	P1	P1	P1	G3	LBP Wd				M7(at)		
A141	Storage	Carpet	Conc	P1	P1	P1	P1	P1							
A142	Office	Carpet	Conc	P1	P1	P1	P1	G2	Wd				M7(at)		
A143	Office	Carpet	Conc	P1	P1	P1	P1	G2	Wd				M7(at)	Mw3(4)	
A144	Office	Carpet	Conc	P1	P1	P1	P1	G2	Wd				M7(at)		
A145	Meeting Room	Carpet	Concrete	P1	P1	P1	P1	G3	Wd				M7		
A146	Corridor	Conc		P1	-	GWB	P1	LBP Wd			B1	C2(2)	M7		
A147	Office	Rubber Tile		P1	P1	P1	P1	G5	LBP Wd				M7(at)		
A148	Washroom	Rubber Tile		P1	P1	P1	P1	P1	LBP Wd		B1(at)	C2(2at)	M7(at)		
A149	Washroom	Rubber Tile		P1	P1	P1	P1	P1	LBP Wd		B1(at)	C2(2at)			
A150	Lunch Room	Rubber Tile		P1	P1	P1	P1	G5	LBP Wd		B1(at)	C2(1at)	M7(at)		
A151	Server Room	Rubber Tile		P1	P1	P1	P1	G1	LBP Wd		B1(at)	C2(3at)	M7(at)		
A152	Corridor	Conc/H5 (3.7)		Wd	-	P1	P1	LBP Wd			B1	C2(2)			
A153	Storage	H5(19.8)		Wd	Wd	Wd	CBW	LBP Wd			B1	C2(1)			
A154	Storage	Conc		CBW/P1	CBW/P1	CBW/P1	CBW/P1	LBP Wd					M7		
A155	Storage	Conc		GWB	Str	P1	GWB	LBP Wd					M7		
A156	Storage	Conc		GWB	CBW	GWB	GWB	LBP Wd							

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Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	I - Vinyl Sheet Flooring	Jp - Cement Pipe	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
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Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Third Ceiling	Mech. Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
A157	Storage	Conc		Str	Str	Str	CBW	LBP Wd							
A158	Library	Carpet	Conc	P1	P1	P1	P1	LBP Wd							
A159	Library	Conc		CBW/Str	P1	Str	Str	LBP Wd							
A160	Office	Carpet	Conc	P1	CBW	P1	P1	G3	LBP Wd						
A161	Map Room	H9		P1	CBW	P1	P1	G3	LBP Wd						
A162	Office	H4		P1	CBW	P1	P1	G5	LBP Wd				M7(at)		
A163	Office	H9	Conc	P1	P1	P1	P1	G5	LBP Wd				M7(at)		
A164	Office	Carpet	Conc	P1	P1	P1	P1	G5	LBP Wd				M7(at)		
A165	Vestibule	Conc		CBW	P1	P1	P1	G3/G5	LBP Wd				M7(at)		
A166	Supplies Centre	Conc		CBW	Wd/Str	Wd/Str	Wd/Str	LBP Wd					M7		
B100	Entry	Ceramic		BW	Glass	BW	Glass	G2	Q-Deck		B1(at)				
B101	Corridor	H4		P2	-	P2	P2	G2/G2/G4							
B102	Office	H5(5.4)		P2	CBW	BW	P2	G2							
B103	Office	H3		P2/CBW	P2	P2	CBW	G2							
B104	Office	H6		P2	P2	P2	P2	G3/G4							
B105	Storage	Conc		P2	P2	BW	P2	G1/G3							
B106	Office	H5(27.4)		P2	CBW	BW	P2	G2/G2/G4							
B107	Office	H5(11.7)		P2	CBW	BW	P2	G2/G2/G4							
B108	Office	H6		P2	CBW	BW	P2	G2							

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B109	Office	H5(11.7)		P2	CBW	BW	P2	G2/G1							
B110	Office	H8		P2	CBW	P2	P2	G1							
B111	Office	H8		P2	CBW	P2	P2	G1							
B112	Office	H6		CBW	CBW	P2	P2	G3							
B113	Office	H5(18.5)		P1	GWB	CBW/BW	CBW/GWB	G2/G3							
B114	Office	H5(16.6)		P2	P2	GWB	GWB	G2/G3							
B115		NO ACCESS													
B116	Corridor	Conc		CBW	CBW	CBW	CBW	G3/G4/G2							
B116A	Corridor	H4/ H5(39.2)	Conc	P2	P2	P2	P2	G2/G3	Q-Deck						
B116B	Corridor	Conc		-	CBW	CBW	CBW	G3/G4/G2							
B117	Radio Room	Conc/Wd		CBW/P2	CBW	CBW	CBW	Q-Deck			B1	C1(30h)		Mw2(1)	
B118	Office	Cork	Conc	CBW	CBW	P2	P2	G3			B1				
B119	Server Room	Conc		P2	P2	CBW	CBW	Q-Deck			B1	C1(12h)	M4		
B120	Lunch Room	Conc		Wd	CBW	CBW	P2	Q-Deck			B1		M6		
B121	Storage	Conc		CBW	CBW	Wd	P2	Q-Deck			B1			Mw2(1)	
B122	Office	Conc		P2	P2	P2	CBW	G3			B1	C1(4L)			
B123	Storage	Conc		CBW	-	P2	CBW	Q-Deck			B1	C1(8)			
B124	Plumbing Shop	Conc		CBW	CBW/P2	CBW/P2	CBW	Q-Deck			B1	C1(30)	M4/M6	Mw2(1)	
B125	Office	H5(9.3)	Conc	P2	CBW	CBW	P2	G2/G3						Mw2(1)/ Mw1(1)	

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B126	Electrical Shop	Conc		CBW	CBW	CBW/P2	CBW/P2	Q-Deck					M4/M6	Mw2(1) / Mw1(1)	
B127	Office	H5(9.3)	Conc	CBW	CBW	P2	P2	G2/G3						Mw2(-)	
B128	Wood Shop	Wd/Conc		CBW	CBW	CBW	CBW/P2	Q-Deck			B1	C1(40)	M2		
B129	Office	Wd		P2	P2	P2	CBW	G2			B1(at)	C1(2)(at)		Mw2(2)	
B130	Storage	Conc		Str	Str	P1	CBW	Wd			B1	C1(4)			
B131	Garage	Conc		Str/Metal	Str/Metal	Str/Metal	Str/Metal	Str/Metal						T1	
B132	Storage	Conc		CBW	CBW	P2/GWB	GWB	Q-Deck			B1	C1(12)	M2	Mw2(2)	
B133	Office	Cork		P2	CBW	CBW	P2	G2						Mw2(-)	
B134	Storage	Conc		GWB/Str	P2/CBW	CBW	P2	Q-Deck			B1	C1(12)			
B135	Office	Rubber		P2	P2	CBW	P2	G2							
B136	Office	I1	Conc	P2/CBW	P2	CBW	CBW				B1	C1(12)	M2		
B137	Corridor	Conc/I1		CBW	-	P2	CBW	Q-Deck			B1	C1(12)	M2		
B138	Boiler Room	Conc		CBW	CBW	CBW	CBW	Q-Deck			B1/Kp1	C1(40)	E1(300sf)/ E2/M4/ M6	Mw1(1)/ K1	
B139	Shower Room	Ip1	Conc	CBW	Ceramic on P2/CBW	Ceramic on P2/CBW	Ceramic on P2	P2							
B140	Washroom	Ceramic		CBW	CBW	CBW/P2	CBW/P2	P2			B1	C1(4L)			
B141	Washroom	Ceramic		P2	P2	P2	CBW	P2				`			
B142	Lunch Room	Ceramic		P2	P2	CBW	CBW	P2			B1	C1(2L)			

Code	Qualifier Number	Visual Description	Sample Number	Asb. Content (Chrysotile)	BUILDING ERA DESIGNATION
		TECH WARDEN BUILDING			
B	1	Fiberglass strait run pipe insulation with Fiberglass pipe fittings (unless noted as C1) - Corridor	Known Non-Asbestos		
C	2	Beige non-fibrous insulating cement on hot water pipe fitting - Corridor A013	3638-04		A
C	1	Beige non-fibrous insulating cement on hot water pipe fitting - Washroom B142	3638-20	20%	B
C	1	Beige non-fibrous insulating cement on hot water pipe fitting - Office B122	3638-24	40%	B
C	1	Beige non-fibrous insulating cement on hot water pipe fitting - Boiler room B138	3638-26	40%	B
C	1	Beige non-fibrous insulating cement on hot water pipe fitting - Room B137	3638-30	30%	B
C	2	Beige non-fibrous insulating cement on hot water pipe fitting - Corridor A146	3638-34		
C	2	Beige non-fibrous insulating cement on domestic cold water pipe fitting - Boiler room A106	3638-36		
C	2	Beige non-fibrous insulating cement on hot water pipe fitting - Boiler room A106	3638-38		
E	1	Boiler exhaust breaching - Boiler room B138	3638-25	40%	B
E	2	Boiler exhaust "B" Vent through ceiling - Boiler Room A106	Suspect Asbestos		
E	2	Canvass wrapped Fiberglass duct insulation - Boiler room B138	Known Non-Asbestos		
G	1	2x4' Cross-directional fissures with large and small pinholed compressed cellulose ceiling tile -	Known Non-Asbestos		
G	2	2x4' Pinholed and textured ceiling tile - General Assembly B102	3638-14		
G	3	2x4' Minimal punch and pinholed compressed cellulose ceiling tile - Corridor B116A	Known Non-Asbestos		
G	4	2x4' Numerous punch and pinholed compressed cellulose ceiling tile - Corridor B116A	Known Non-Asbestos		
G	5	2x4' Short omni-directional fissures with large and small pinholed compressed cellulose ceiling	Known Non-Asbestos		
H	1	12x12" Cream with long brown streaked VFT - Corridor A013A	3638-01		
H	2	12x12" Cream with long grey streaked VFT - Storage A010	3638-08		
H	3	12x12" Cream beige and grey small splotched VFT - Office A007	3638-10		
H	4	12x12" Blue with turquoise small splotched Tarkett VFT - Corridor B116A	Known Non-Asbestos		
H	5	12x12" Tan with minimal brown streaked VFT - Corridor B116A	3638-13	1%	B
H	6	12x12" Beige brown and cream small splotched VFT - Office B108	3638-17		
H	7	12x12" White with grey and light grey small splotched VFT - Office B104	3638-18		
H	8	12x12" Orange/brown with cream and light brown small streaked Tarkett VFT - Office B110	Known Non-Asbestos		
H	9	12x12" White with grey, green and yellow splotched for VFT - Office A163	3638-32		
H	10	12x12" Cream with small' beige splotched VFT - Storage A127	3638-44		
I	1	Cream with beige and brown small splotched Tarkett VSF - Office 136	Known Non-Asbestos		
I	2	Green with dark green and cream small splotched and dimple textured VSF - Reception A116	Known Non-Asbestos		
Ip	1	White and beige 2" square pattern VSF - Shower room B139	3638-27		
K	1	Segmented cube boiler internal packing - Boiler room B138	Suspect Asbestos		
Kp	1	Pipe flange gaskets - Boiler room A106	3638-37		
Kp	1	Red rubber pipe flange gasket on sprinkler lines - Boiler room A106	Known Non-Asbestos		
M	1	Red/Brown high velocity duct joint sealant - Corridor A013	3638-02		
M	1	Red/Brown high velocity duct joint sealant - Storage A006	3638-06		
M	2	Grey high velocity duct joint sealant - Storage A021	3638-12		
M	2	Grey high velocity duct joint sealant - Wood Shop B128	3638-28	5%	B
M	3	Black Styrofoam mastic glue on concrete foundation wall - Storage A021	3638-11		
M	4	Gold high velocity duct joint sealant - General Assembly B102	3638-15	5%	B
M	5	Grey window panel sealant - West exterior	3638-19	5%	
M	6	Grey high velocity duct joint sealant - Lunch room B120	3638-23	5%	B
M	7	Brown high velocity duct joint sealant - Vestibule A165	3638-31		
M	7	Brown high velocity duct joint sealant - Corridor A146	3638-33		
M	7	Brown high velocity duct joint sealant - Storage A127	3638-45		
M	8	Grey fibre gum on electrical penetration - Electrical room A107	3638-39		
M	9	Brown fibre gum on electrical penetration - Electrical room A107	3638-40		
M	10	Black roof penetration sealant - Roof	3638-77		
M	11	Grey roof penetration sealant - Roof	3638-78	1%	

M	12	Grey AHU (HV-2) electrical penetration sealant - Roof	3638-79	8%	
M	13	AHU gas penetration tar pot _ Roof	3638-80		
M	14	Black roof penetration - Roof	3638-81		
Mw	1	Soft grey interior window putty - Corridor A013C	3638-09	2%	A
Mw	2	Soft grey exterior window putty - Radio room B117	3638-22	5%	B
Mw	3	Soft black interior window putty - Office A143	3638-41		
Mw	4	Soft black skylight window putty - Roof	3638-76		
N	1	Cast iron bell and spigot joint packing - Corridor A013	Known Asbestos	90%	A & B
P	1	White drywall tape compound - Corridor A013A	3638-03		
P	1	White drywall tape compound - Corridor A013C	3638-05		
P	1	White drywall tape compound - Corridor A002	3638-07		
P	1	White drywall tape compound - Entry A112	3638-42		
P	1	White drywall tape compound - Storage A127	3638-43		
P	2	Beige drywall tape compound - Radio room B108	3638-16	1%	B
P	2	Beige drywall tape compound - Radio room B117	3638-21	1%	B
P	2	Beige drywall tape compound - Wood shop B128	3638-29		
Qf	1	Torch on roof membrane - Roof	3638-82		
R	1	Refractory cement on top of boiler segments - Boiler room A106	3638-35	5%	A
T	1	Foil faced Fiberglass bat building thermal insulation - Garage B131	Known Non-Asbestos		

OTHER HAZARDOUS AND REGULATED MATERIALS

LEAD BASED PAINT (provide visual description and sample/ID location)	Swab Sample No.	Swab Result
Grey on concrete floor - Work Room A018	LBP #01	No Lead Detected
White on concrete block wall - Work Room A108	LBP #02	No Lead Detected
Cream on concrete floor - Office A019	LBP #03	No Lead Detected
Light green on concrete column - Storage A006	LBP #04	No Lead Detected
Cream on exterior wood soffits - West exterior	LBP #05	Lead Detected >600ppm
Cream on metal ductwork - Locker room A014	LBP #06	No Lead Detected
Cream on white primer on wood ceiling ship lap - Vestibule A165	LBP #07	Lead Detected >600ppm
Red oxide primer on structural steel - Throughout	LBP #08	Lead Containing Application
Beige on concrete block wall - Stores A154	LBP #09	No Lead Detected
Cream on concrete block wall (original colour) - Stores A154	LBP #10	Lead Detected >600ppm
White on concrete block wall (top coat) - Stores A154	LBP #11	No Lead Detected
LEAD CONTAINING MATERIALS		
Comments Regarding Lead Containing Applications:		

PCB (provide running quantity)	Quantity
PCB containing fluorescent light ballasts	T-8 / T-12 (500)
Suspect PCB containing electrical transformers	-
MERCURY (provide quantity of each application)	**Quantity**
Mercury containing wall mounted thermostats	12
Mercury containing high voltage lighting	-
Mercury containing fluorescent light tubes	1200
TOXIC FLAMMABLE EXPLOSIVE MATERIALS (provide quantity of each application)	**Quantity**
Paints	Owner Used
Oils/solvents/fuel	Owner Used
Mould contamination	-
Rodent Contamination	-
Pigeon/Bat Contamination	-
Biological Hazards	-
ODS (Ozone Depleting Substances)	**Quantity**
Roof top HVAC units	6
Wall mounted air conditioners	-
Refrigerators/Deep Freezers	Owner Used

ROOM BY ROOM INVENTORY

Building Name: Parks Canada Banff Garage Building Date: 09/22/2016 (mm/dd/\yyyy) ANCILLARY INFORMATION

TB-Tack Board / GWB-Gypsum Wall Board / BW-Brick Wall / CBW-Concrete Block Wall / Car-Carpet / Conc-Concrete / STR-Structure / WD-Wood / FRP-fibreglass reinforced plastic

All applications are below accessible below 8 foot height unless otherwise noted as (h)-high for applications above 8' or as being (at)-Application concealed above T-bar ceilings /

(*) - assumed applications room not accessible / (af)-concealed above fixed ceilings / (uc)-concealed beneath carpeting / (uv)-concealed beneath vinyl sheeting / (ul)-concealed beneath laminate flooring

Application quantities are shown in Brackets (50) - All applications are in good condition unless noted as ... (p) poor or (f) fair

Only know or visually site confirmed asbestos applications are noted on these Ancillary Pages. Additional asbestos applications may be present within the rooms listed herein, but not shown on this spreadsheet.

Yellow highlighting indicates asbestos applications

BLUE highlighting indicates suspect asbestos application

A - Texture Coating	D - Cement Parging	***BUILDING MATERIAL IDENTIFICATION CODES***		K - Equipment Gasketing	N - Pipe Roving/Packing	Qs - Roofing Shingle	U - Friction Materials
Ac - Acoustic Insulation	E - Exhaust Breeching	G - Ceiling Panel	J - Cement Board	Kp - Pipe Gasketing	O - Floor Levelling Cement	R - Refractory Cement	V - Vermiculite Wall
Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	H -Vinyl Floor Tile	Jf - Asbestos Furnishings	L - Incandescent Light Pad	P - Dryw all Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	I - Vinyl Sheet Flooring	Jp - Cement Pipe	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	Third Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Mech. Piping	Sanitary Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
	GARAGE BUILDING															
	Roof	Qf1													M1(4)/M3(8)/M4/M5(2)	
	Exterior				S1	S1	S1	S1							D1	
	Throughout Applications											N1				
	Ceiling Space	Pl1			Str	Str	Str	Str	Wd				C1(100)			
100	Vestibule	Conc			CBW	Conc/Glass	CBW	Wd/Glass	P1							
101	Corridor	Conc			CBW	Wd/Glass	CBW		P1		B1		C1(2)	M1		
102	Lunch Room	H1(53.6)			Pl1	Pl1	Pl1	Pl1	G1						Mw1(3)	
103	Change Room	Conc			CBW	CBW	CBW	CBW	Pl1	Wd	B1/ B1(at)		C1(at)			
104	Washroom	Conc			Pl1	Pl1	Pl1	Pl1	Pl1	Wd						
105	Office	H2	Conc		Pl1	Pl1	Pl1	Pl1	Pl1							
106	Office	H2	Conc		Pl1	Pl1	Pl1	Pl1	Pl1		B1					
107	Purchasing	H2	Conc		CBW	CBW	CBW	CBW	G3							
108	Vestibule	Conc			Pl1	Pl1	Pl1	Pl1	Pl1							
109	Washroom	Conc			Pl1	Pl1	Pl1	Pl1	Pl1							
110	Office	I1	Conc		P1	P1	P1	P1	G1	LBP Wd(at)						
111	Office	I1	Conc		P1	P1	P1	P1	G1	LBP Wd(at)						
112	Reception	Ip1	Conc		CBW	CBW	P1	P1	A1 on P1							

ROOM BY ROOM INVENTORY

Building Name: Parks Canada Banff Garage Building Date: 09/22/2016 (mm/dd/\yyyy) ANCILLARY INFORMATION

TB-Tack Board / GWB-Gypsum Wall Board / BW-Brick Wall / CBW-Concrete Block Wall / Car-Carpet / Conc-Concrete / STR-Structure / WD-Wood / FRP-fibreglass reinforced plastic

All applications are below accessible below 8 foot height unless otherwise noted as (h)-high for applications above 8' or as being (at)-Application concealed above T-bar ceilings /

(*) - assumed applications room not accessible / (af)-concealed above fixed ceilings / (uc)-concealed beneath carpeting / (uv)-concealed beneath vinyl sheeting / (ul)-concealed beneath laminate flooring

Application quantities are shown in Brackets (50) - All applications are in good condition unless noted as ... (p) poor or (f) fair

Yellow highlighting indicates asbestos applications

Only know or visually site confirmed asbestos applications are noted on these Ancillary Pages. Additional asbestos applications may be present within the rooms listed herein, but not shown on this spreadsheet.

BLUE highlighting indicates suspect asbestos application

BUILDING MATERIAL IDENTIFICATION CODES							
A - Texture Coating	D - Cement Parging	G - Ceiling Panel	J - Cement Board	K - Equipment Gasketing	N - Pipe Roving/Packing	Qs - Roofing Shingle	U - Friction Materials
Ac - Acoustic Insulation	E - Exhaust Breeching	H - Vinyl Floor Tile	Jf - Asbestos Furnishings	Kp - Pipe Gasketing	O - Floor Levelling Cement	R - Refractory Cement	V - Vermiculite Wall
Af - Spray-Applied Fireproofing	F - Insulating Paper Wrap	I - Vinyl Sheet Flooring	Jp - Cement Pipe	L - Incandescent Light Pad	P - Drywall Tape Comp.	S - Exterior Wall Stucco	Va - Vermiculite Attic
B - Pipe Insulation	Fj - Insulating Paper Joint	Ip - Paper Backed Flooring	Jw - Cement Board Window Panel	M - Mastic Glue / Sealant	Pl - Plaster	Ss - Exterior Soffit Stucco	W - Woven Textile
C - Cement Pipe Fitting	Fb - Insulated Duct Boot			Mw - Window Putty	Qf - Roofing Felt	T - Bldg Thermal Insulation	X - Fire Doors

Room No.	Room Name	Top Visible Floor Layer	Second Floor Layer	Third Floor Layer	North Wall	East Wall	South Wall	West Wall	First Visible Ceiling	Second Ceiling	Mech. Piping	Sanitary Piping	Pipe Fitting	Mech. Ducting	Other	Quantities
113	Office	Ip1	Conc		Pl1	Pl1	Pl1	Pl1	Pl1							
114	Office	Conc			CBW/P1	CBW	CBW	P1	Wd					M1		
115	Electrical Room	Conc			CBW	CBW	CBW	CBW	Pl1		B1		C1(6)			
116	Boiler Room	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1/Kp1/ K1(2)/R2		C1(70)	E1/E2	Af1	
117	Storage	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1		C1(20)	M1	Af1	
118	Battery Room	Conc			CBW	CBW	CBW	CBW	P1	LBP Wd	B1(af)		C1(6af)	M1(af)		
119	Storage	Conc			CBW	CBW	P1	CBW	LBP Wd		B1			M1	Af1	
120	General Workshop	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1	N1	C1(10)	M1	Mw1(20)	
121	Welding Shop	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1	N1	C1(4)	M1	Mw1(6)	
122	Welding Shop	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1	N1	C2(4)	M1		
123	Body Repair	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1	N1		M1		
124	Electrical Room	Conc			CBW	CBW	CBW	CBW	LBP Wd		B1	N1	C2(4)	M1	Mw1(6)	

Code	Qualifier Number	Visual Description - Visually Assessed Location	Sample Number	Asb. Content (Chrysotile)
		GARAGE BUILDING		
A	1	Stipple ceiling texture - Recpetion 112	3638-53	
Af	1	Cemetitious fireproofing - Storage 119	3638-55	
Af	1	Cemetitious fireproofing - Storage 119	3638-56	
Af	1	Cemetitious fireproofing - Storage 117	3638-57	
Af	1	Cemetitious fireproofing - Boiler room 118	3638-59	
B	1	Fiberglass strait run pipe insulation - Corridor 101	Known Non-Asbestos	
C	1	Beige non-fibreious insulating cement on hot water pipe fitting - Corridor 101	3638-47	8%
C	1	Beige non-fibreious insulating cement on hot water pipe fitting - Change room 103 ceiling spac	3638-51	2%
C	1	Beige non-fibreious insulating cement on hot water pipe fitting - Boiler room 118	3638-62	
C	1	Beige non-fibreious insulating cement on domestic cold water pipe fitting - Boiler room 118	3638-63	10%
C	2	Hard beige insulating cement on rainwater leader pipe Fiberglass insulation joints and roof drai	3638-65	30%
C	2	Hard beige insulating cement on rainwater leader pipe Fiberglass insulation joints and roof drai	3638-67	30%
D	1	Cement -arguing on lower concrete foundation wall - Southeast exterior	3638-66	
E	1	Boiler exhaust breaching insulation - Boiler room 118	3638-60	
E	1	Boiler exhaust breaching insulation - Boiler room 118	3638-61	
E	2	Canvass wrapped Fiberglass duct insulation - Boiler room 118	Known Non-Asbestos	
G	1	1x1' Large and small holed compressed cellulose glue up tile with suspect asbestos glue ceilin	Suspect Asbestos	
G	2	2x4' Short omni directional fissures with large and small pinholed compressed cellulose ceiling	Known Non-Asbestos	
G	3	2x4' Pinholed and textured ceiling tile - Purchasing 107	Known Non-Asbestos	
H	1	12x12" Tan with brown and white streaked VFT - Lunch Room 102	3638-48	2%
H	2	12x12" Beige with brown and cream VFT - Office 106	3638-54	
I	1	Red with red splotched Tarkett VSF - Office 111	Known Non-Asbestos	
Ip	1	Grey brown cream and yellow waved pattern Tarkett VSF - Reception 112	Known Non-Asbestos	
K	1	Volcano boiler packing and gasketing - Boiler room 118	Suspect Asbestos	
Kp	1	Pipe flange gasketing - Boiler room 118	Known Asbestos	70%
M	1	Grey high velocity duct joint sealant - Corridor 101	3638-46	
M	1	Grey high velocity duct joint sealant - Welding 122	3638-64	
M	1	Grey high velocity duct joint sealant - Roof	3638-71	
M	2	Black sealant on boiler exhaust breaching - Roof	3638-68	
M	3	Black tar pot sealant on AHU Penetrations - Roof	3638-69	
M	4	Black on grey flashing tar - Roof	3638-70	5%
M	5	Red exhaust fans duct joint sealant - Roof	3638-72	
M	6	Grey sealant between window lintel stonework - Roof	3638-73	
Mw	1	Hard white window putty - Lunch room 102	3638-49	
N	1	Cast iron sanitary and rain water leader piping bell and spigot packing - Welding 122	Known Asbestos	90%
Pl	1	Finished plaster - Change room 103	3638-50	
Pl	1	Finished plaster - Electrical room 115	3638-52	
Qf	1	Torch on roof membrane - Roof	3638-75	
R	1	Boiler burner refractory cement - Boiler room 118	3638-58	
R	2	Boiler internal refractory cement - Boiler room 118	Suspect Asbestos	
S	1	Exterior stucco - Roof	3638-74	

OTHER HAZARDOUS AND REGULATED MATERIALS

LEAD BASED PAINT (provide visual description and sample/ID location)	Swab Sample No.	Swab Result
Red oxide primer under cream on structural steel - Storage 119	LBP #01	Lead Detected >600ppm
Cream on wood ship lap ceiling - Storage 119	LBP #02	Lead Detected >600ppm
Cream on concrete block wall - General workshop 122 north wall	LBP #03	Lead Detected >600ppm
White over cream on concrete block wall - General workshop 122 north wall	LBP #04	Lead Detected >600ppm

LEAD CONTAINING MATERIALS
Comments Regarding Lead Containing Applications:

PCB (provide running quantity)	Quantity
PCB containing fluorescent light ballasts	T-8 / T12(150)
Suspect PCB containing electrical transformers	-

MERCURY (provide quantity of each application)	Quantity
Mercury containing wall mounted thermostats	10
Mercury containing high voltage lighting	20
Mercury containing fluorescent light tubes	300

TOXIC FLAMMABLE EXPLOSIVE MATERIALS (provide quantity of each application)	Quantity
Paints	-
Oils/solvents/fuel	Owner Used
Mould contamination	-
Rodent Contamination	-
Pigeon/Bat Contamination	-
Biological Hazards	-

ODS (Ozone Depleting Substances)	Quantity
Roof top HVAC units	4
Wall mounted air conditioners	-
Refrigerators/Deep Freezers	Owner Used

Peak Environmental Ltd.
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Appendix C - Photo Log

Photo 1

The front (south side) of the Warden/Tech/Trades Building.

Photo 2

A view of the west side of the Warden/Tech/Trades Building.

Photo 3

A view of the front (east side) of the Garage Building.

Photo 4

Sample 3638-01, vinyl floor tile collected from A013A – Asbestos negative

Photo 5

Sample 3638-02, duct sealant collected from A013 – Asbestos negative

Photo 6

Sample 3638-03, drywall joint compound collected from A013A – Asbestos negative

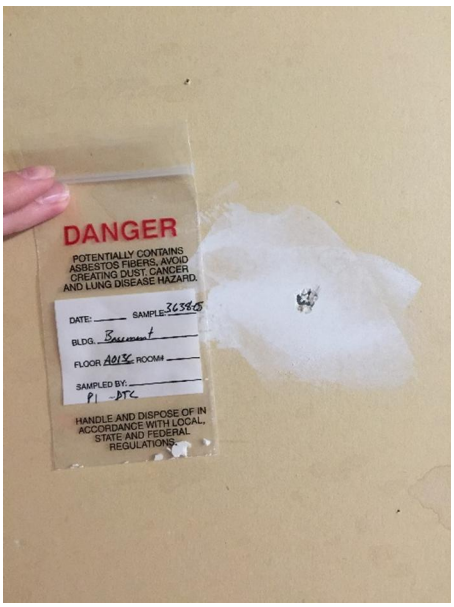


Photo 7

Sample 3638-05, drywall joint compound collected from A013C – Asbestos negative

Photo 8

Sample 3638-06, Duct sealant collected from A006 – Asbestos negative

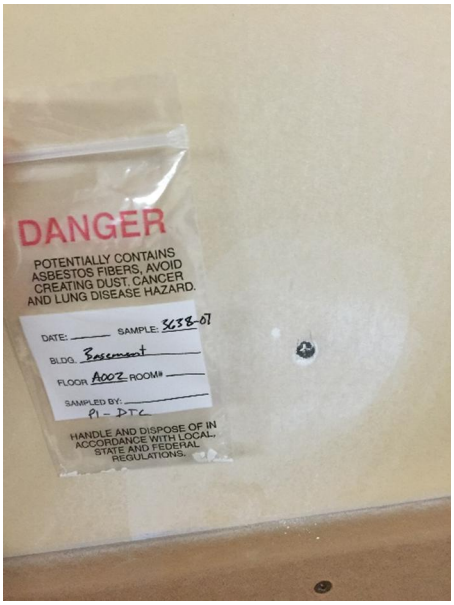


Photo 9

Sample 3638-07, drywall joint compound collected from A002 – Asbestos negative

Photo 10

Sample 3638-08, vinyl flooring tile collected from A010 – Asbestos negative

Photo 11

Sample 3638-09, window putty collected from A013C – Asbestos positive

Photo 12

Ceiling tile from A007 – Non asbestos

Photo 13

Sample 3638-10, vinyl flooring tile collected from A007 – Asbestos negative

Photo 14

Sample 3638-11, mastic collected from A021 – Asbestos negative

Photo 15

Sample 3638-12, duct sealant collected from A021 – Asbestos negative

Photo 16

Turquoise flooring tile from B116A – Non asbestos

Photo 17

Sample 3638-13, vinyl flooring tile collected from B116A – Asbestos positive

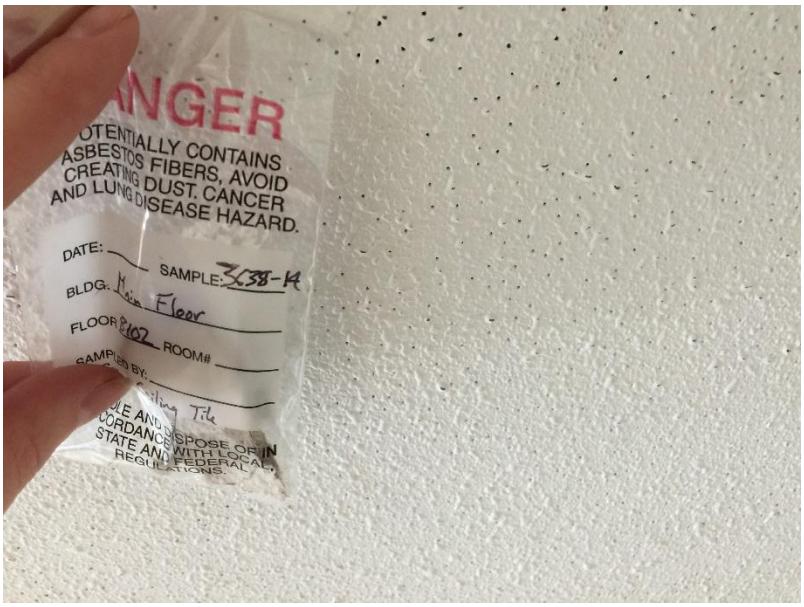


Photo 18

Sample 3638-14, ceiling tile collected from B102 – Asbestos negative

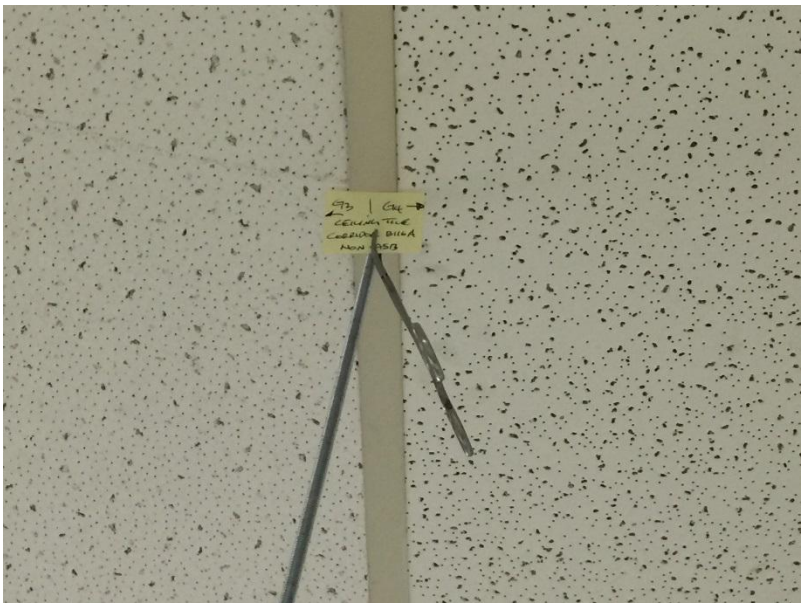


Photo 19

Ceiling Tiles from B116A – Non asbestos

Photo 20

Sample 3638-15, duct sealant collected from B102 – Asbestos positive

Photo 21

Sample 3638-16, drywall joint compound collected from B106 – Asbestos positive

Photo 22

Sample 3638-17, vinyl flooring tile collected from B108 – Asbestos negative

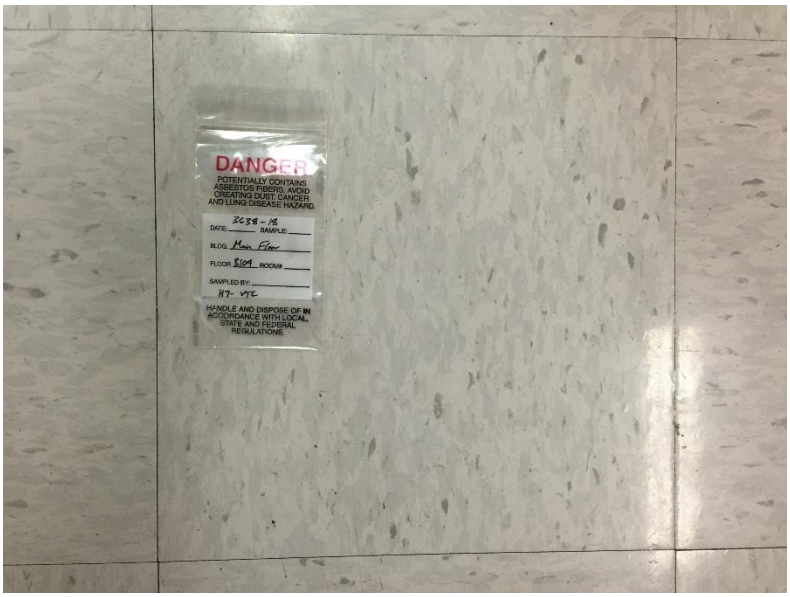


Photo 23

Sample 3638-18, vinyl flooring tile collected from B104 – Asbestos negative

Photo 24

Sample 3638-19, window putty collected from West Exterior, Main Floor – Asbestos positive

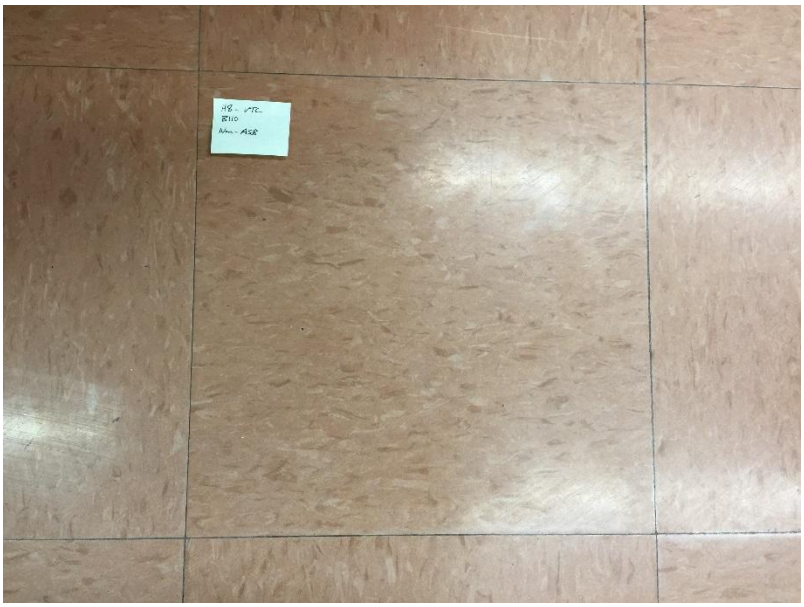


Photo 25

Flooring tile from B110 – Non asbestos

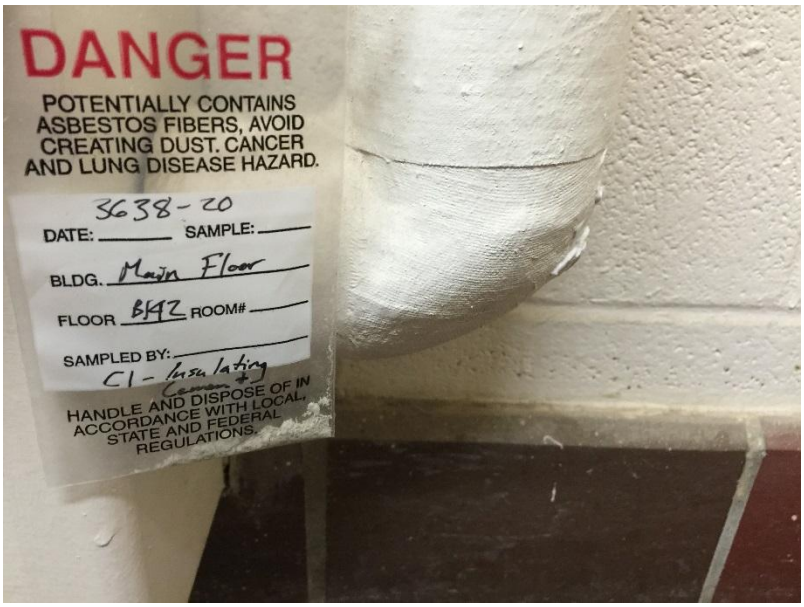


Photo 26

Sample 3638-20, insulating cement collected from B142 – Asbestos positive

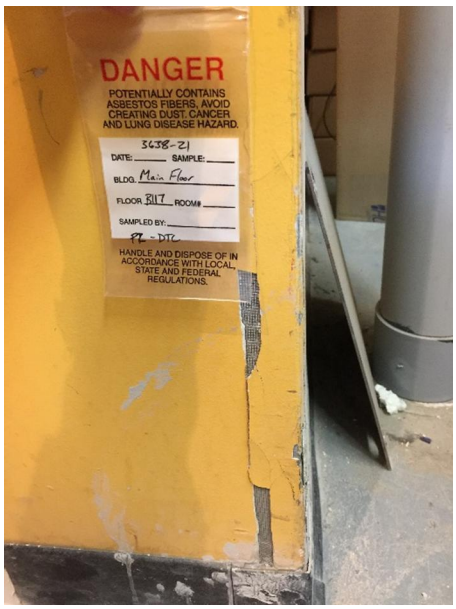


Photo 27

Sample 3638-21, drywall joint compound collected from B117– Asbestos positive

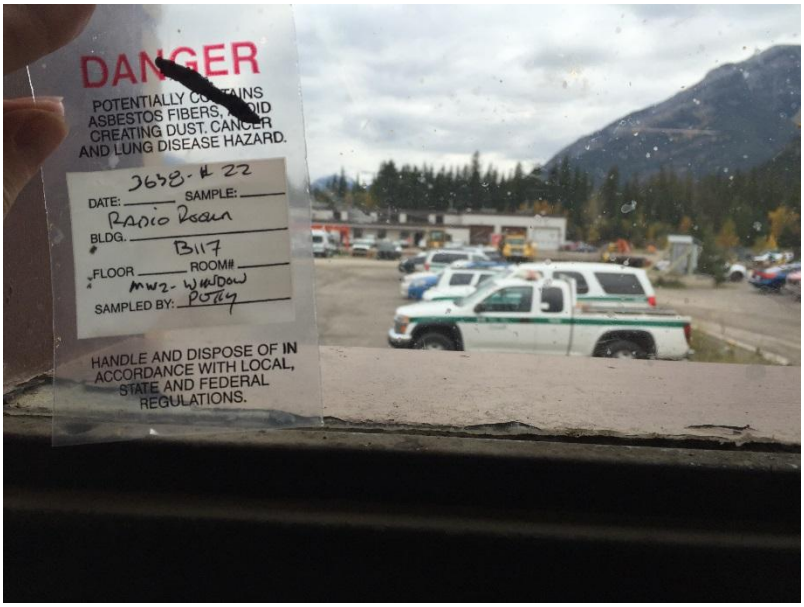


Photo 28

Sample 3638-22, window putty collected from B117 – Asbestos positive

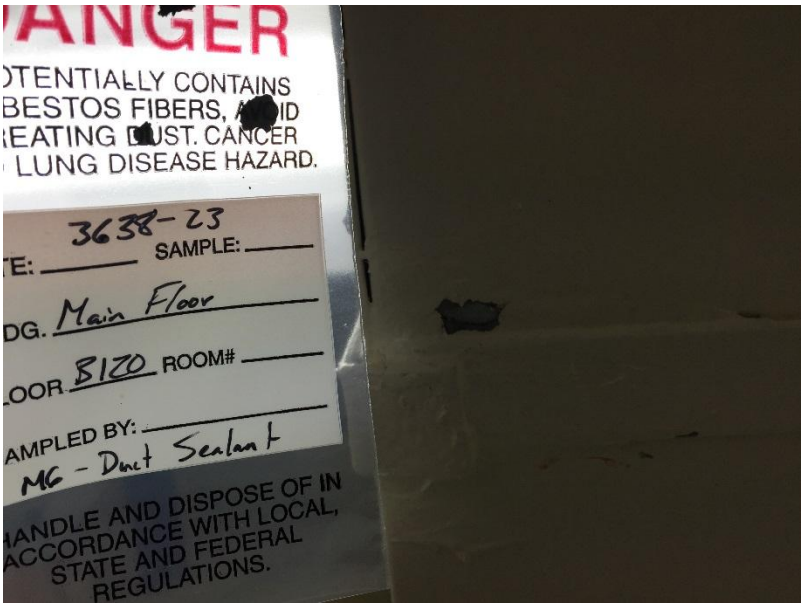


Photo 29

Sample 3638-23, duct sealant collected from B120 – Asbestos positive

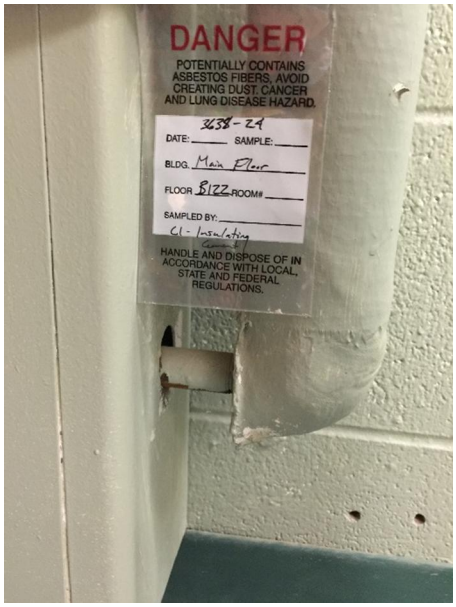


Photo 30

Sample 3638-24, insulating cement collected from B122 – Asbestos positive

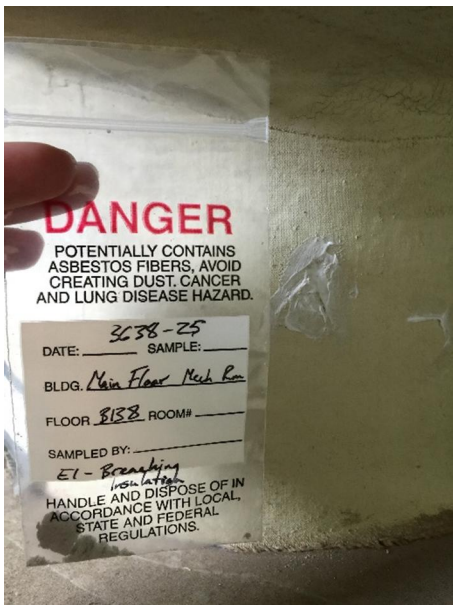


Photo 31

Sample 3638-25, pipe insulation collected from B138 – Asbestos positive

Photo 32

Boiler exhaust breaching in boiler room B138

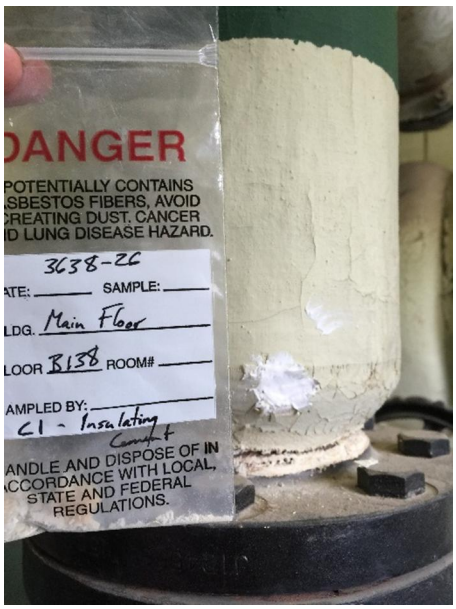


Photo 33

Sample 3638-26, insulating cement collected from B138 – Asbestos positive

Photo 34

Pipe flange gasket from B138 – Suspect Asbestos

Photo 35

Sample 3638-27, sheet vinyl flooring collected from B139 – Asbestos negative

Photo 36

Sample 3638-28, duct sealant collected from B128 – Asbestos positive

Photo 37

Sample 3638-29, drywall joint compound collected from B128 – Asbestos negative

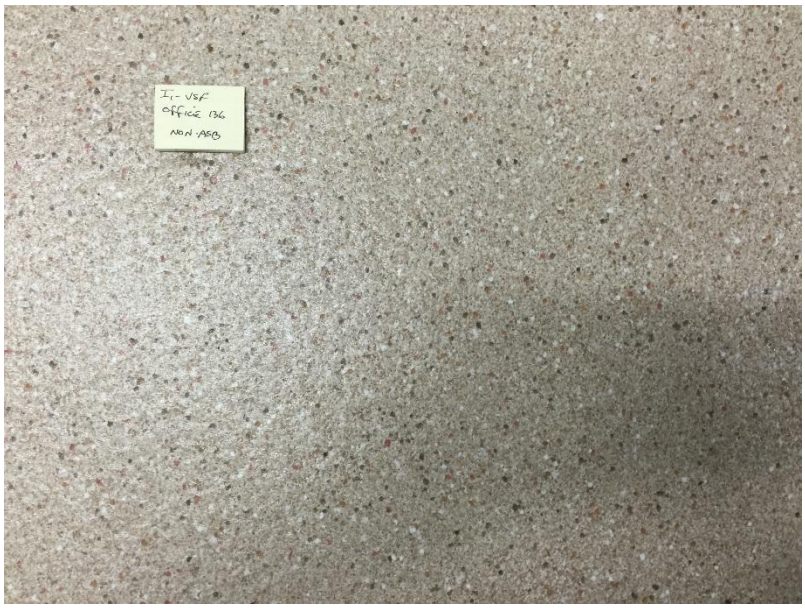


Photo 38

Vinyl Sheet flooring from B136 – Non asbestos

Photo 39

Sample 3638-31, duct sealant collected from A165 – Asbestos negative

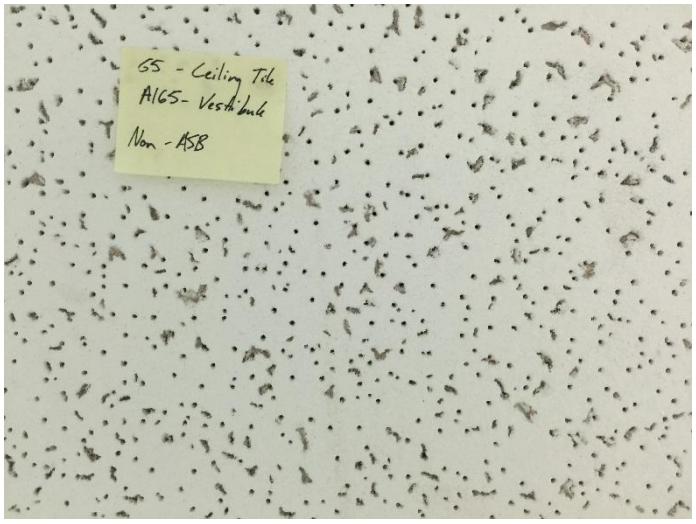


Photo 40

Ceiling tile from A165 – Non asbestos

Photo 41

Sample 3638-32, vinyl flooring tile collected from A163 – Asbestos negative

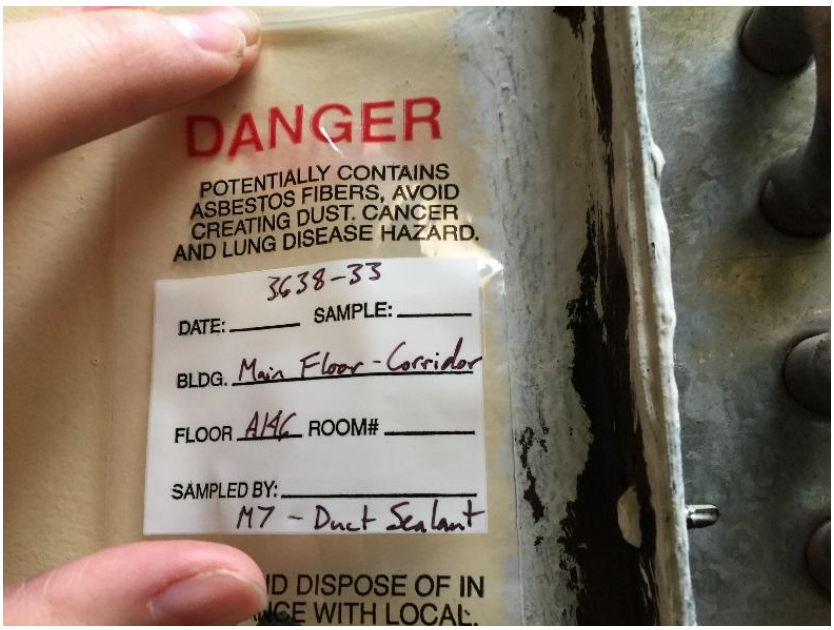


Photo 42

Sample 3638-33, duct sealant from A146 – Asbestos negative

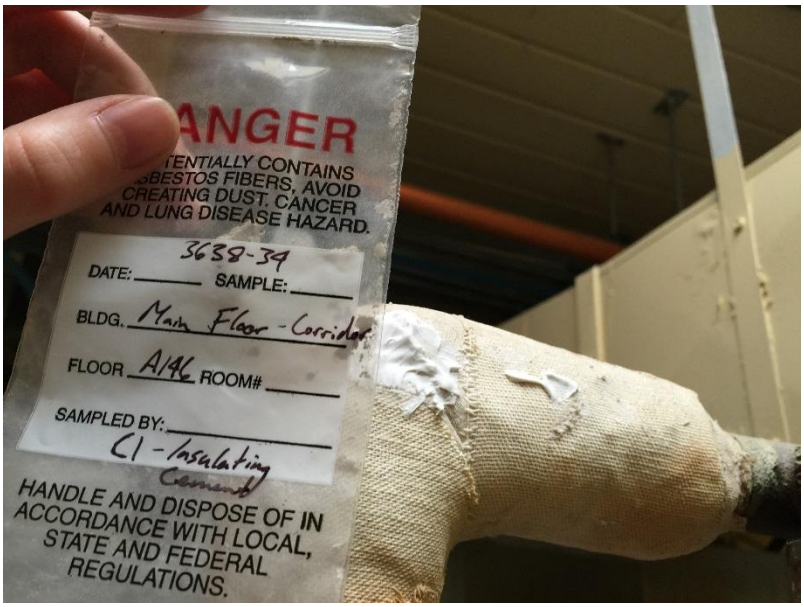


Photo 43

Sample 3638-34, insulating cement collected from A146 – Asbestos negative

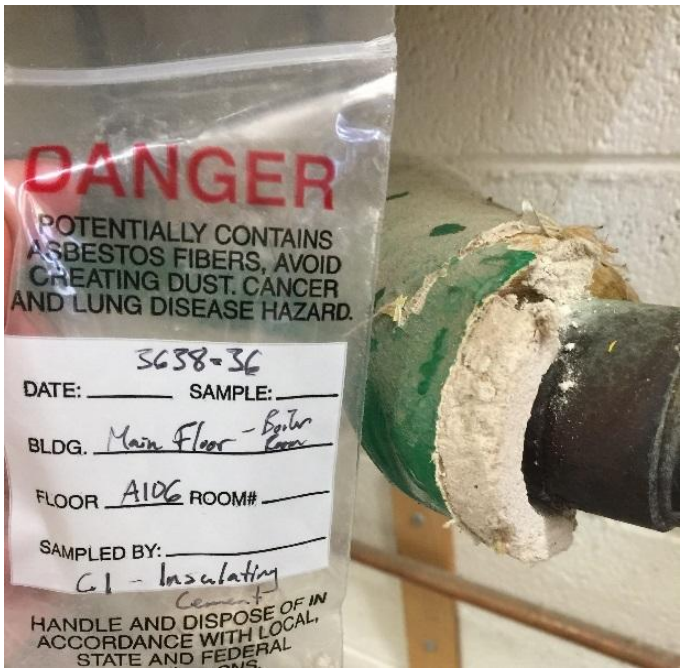


Photo 44

Sample 3638-36, insulating cement collected from A106 – Asbestos negative

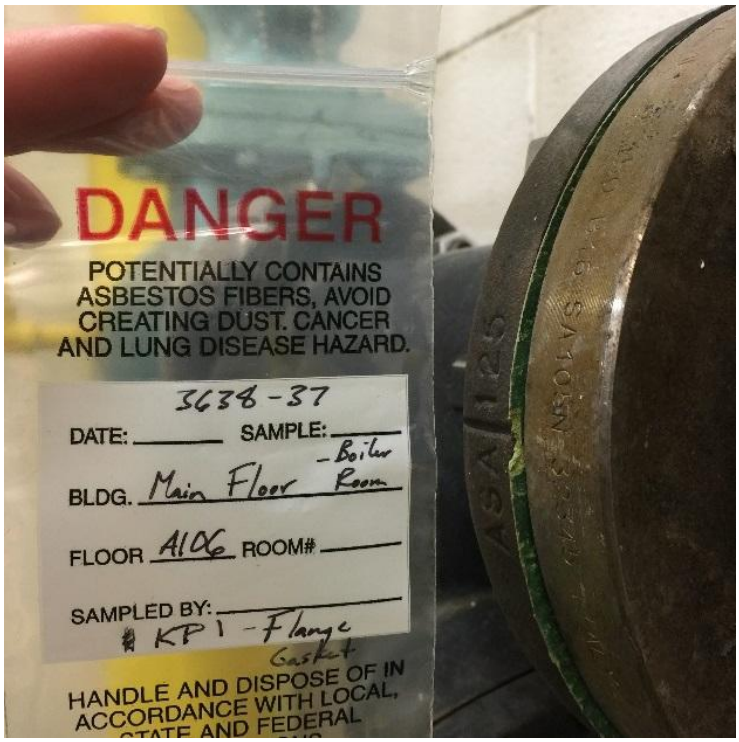


Photo 45

Sample 3638-37, pipe gasket collected from A106 – Asbestos negative

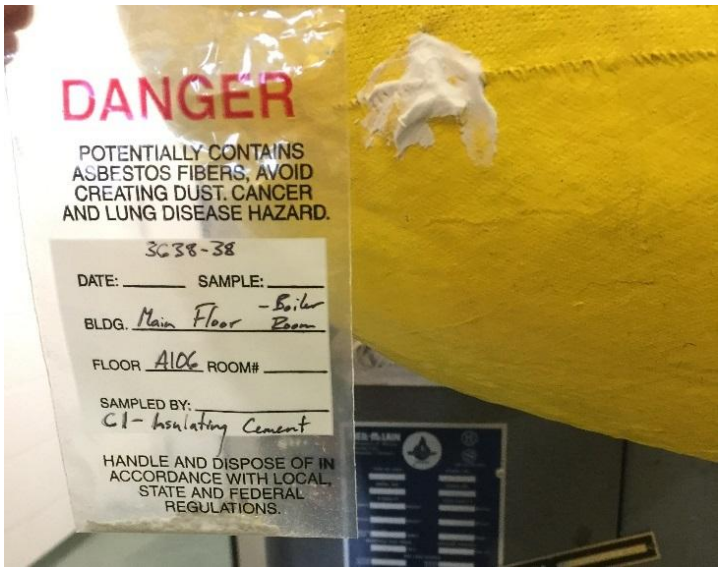


Photo 46

Sample 3638-38, insulating cement collected from A106 – Asbestos negative

Photo 47

Sample 3638-39, fibregum collected from A107 – Asbestos negative

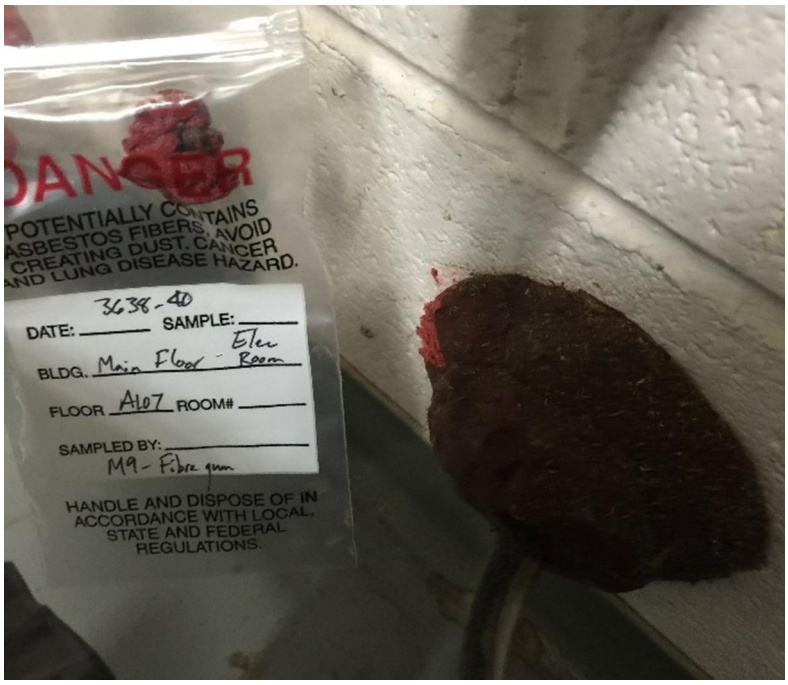


Photo 48

Sample 3638-40, fibregum collected from A107 – Asbestos negative

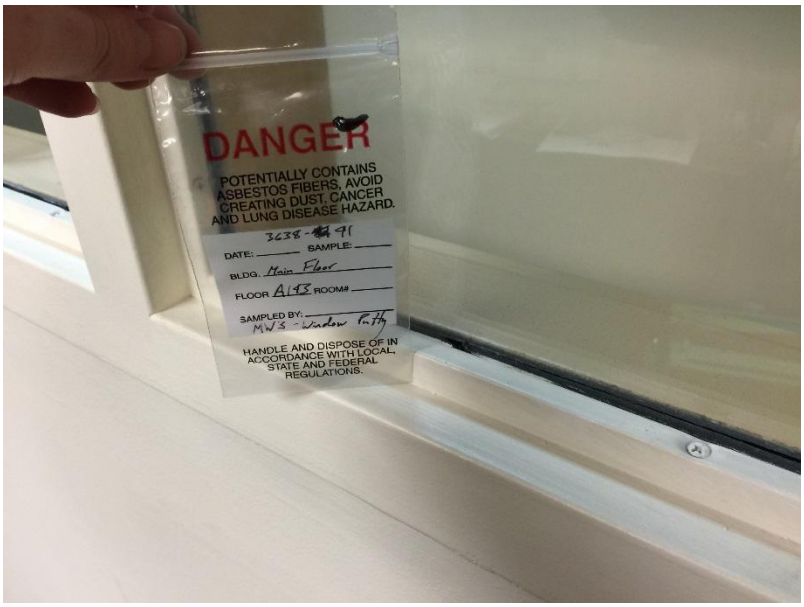


Photo 49

Sample 3638-41, window putty collected from A143 – Asbestos negative

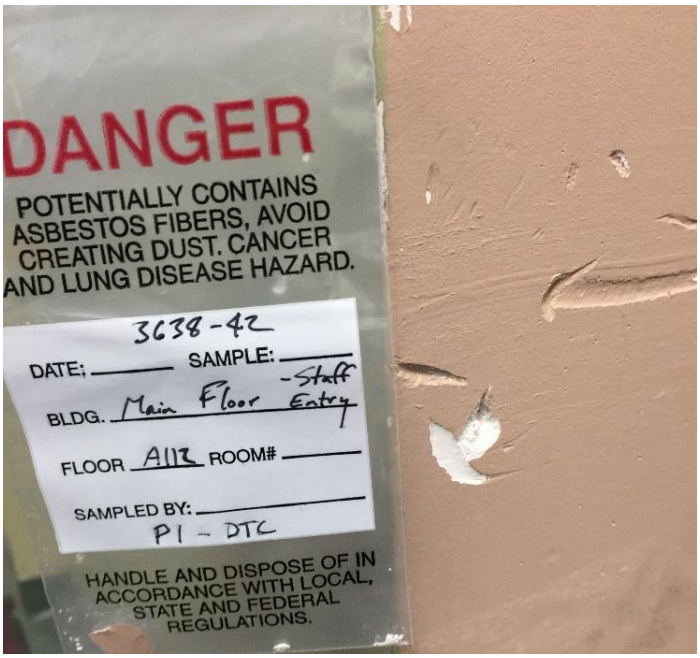


Photo 50

Sample 3638-42, drywall joint compound collected from A112 – Asbestos negative

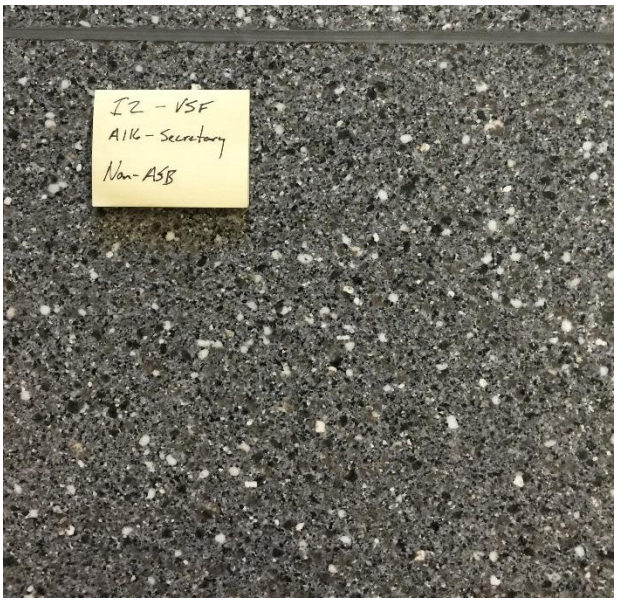


Photo 51

Flooring tile from A116 – Non asbestos

Photo 52

Sample 3638-43, drywall joint compound collected from A127 – Asbestos negative

Photo 53

Sample 3638-44, flooring tile collected from A127 – Asbestos negative

Photo 54

Sample 3638-45, duct sealant collected from A127 – Asbestos negative

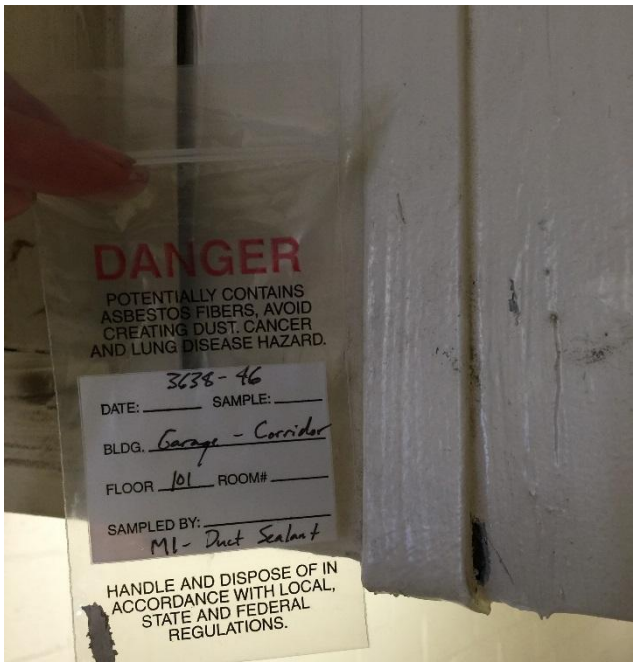


Photo 55

Sample 3638-46, duct sealant collected from 101 – Asbestos negative

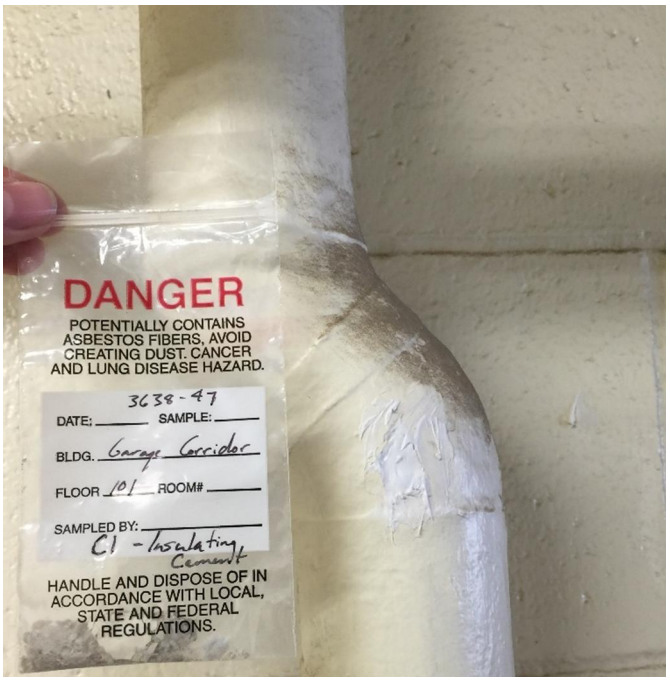


Photo 56

Sample 3638-47, insulating cement collected from 101 – Asbestos positive

Photo 57

Sample 3638-48, vinyl flooring tile collected from 102 – Asbestos positive

Photo 58

Sample 3638-49, window putty collected from 102 – Asbestos negative

Photo 59

Sample 3638-50, plaster collected from 103 – Asbestos negative

Photo 60

Sample 3638-51, insulating cement collected from 103 – Asbestos positive

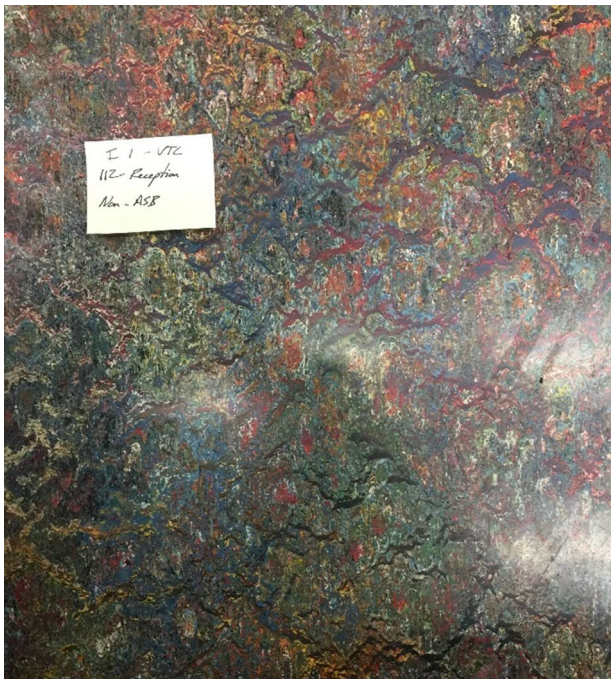


Photo 61

Flooring tile from 112 – Non asbestos

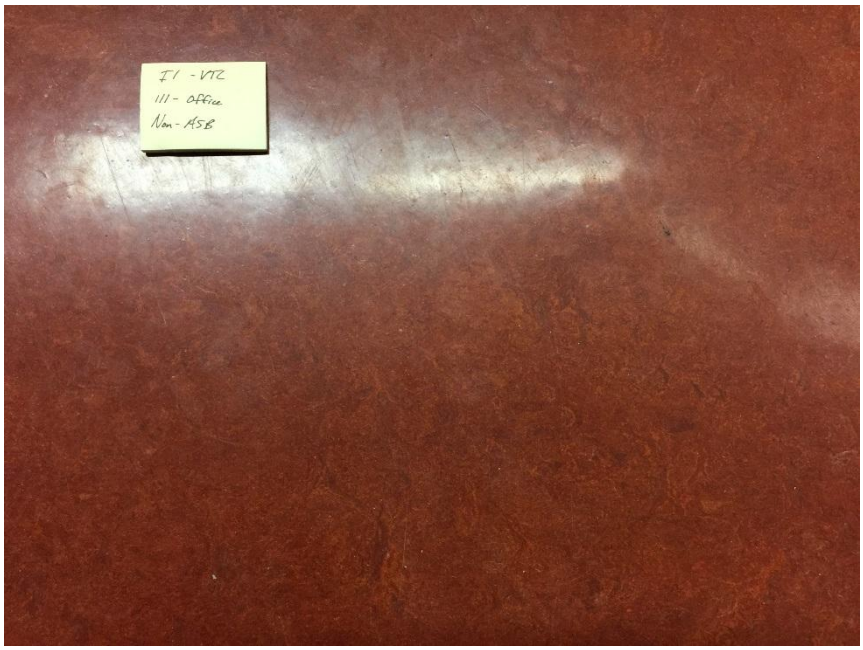


Photo 62

Flooring tile from 111 – Non asbestos

Photo 63

Ceiling tile from 111 – Non asbestos

Photo 64

Sample 3638-52, plaster collected from 115 – Asbestos negative

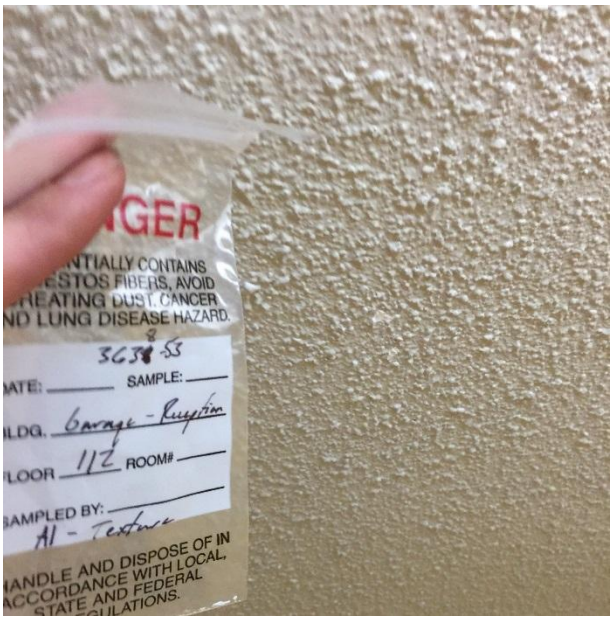


Photo 65

Sample 3638-53, textured ceiling collected from 112 – Asbestos negative

Photo 66

Sample 3638-54, vinyl flooring tile collected from 106 – Asbestos negative

Photo 67

Ceiling tile from 107 – Non asbestos

Photo 68

Sample 3638-55, fire proofing collected from 119 – Asbestos negative

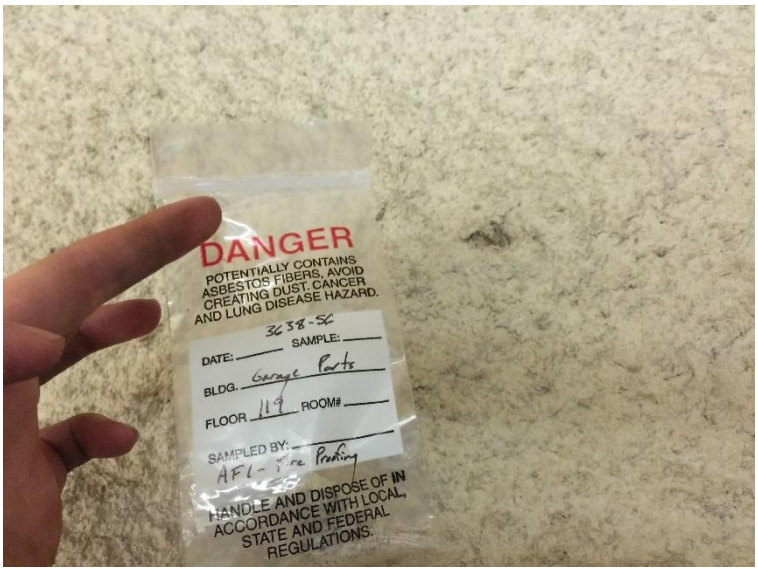


Photo 69

Sample 3638-56, fire proofing ceiling collected from 119 – Asbestos negative

Photo 70

Sample 3638-57, fire proofing collected from 117 – Asbestos negative

Photo 71

Sample 3638-58, Refractory Cement collected from 116 – Asbestos negative

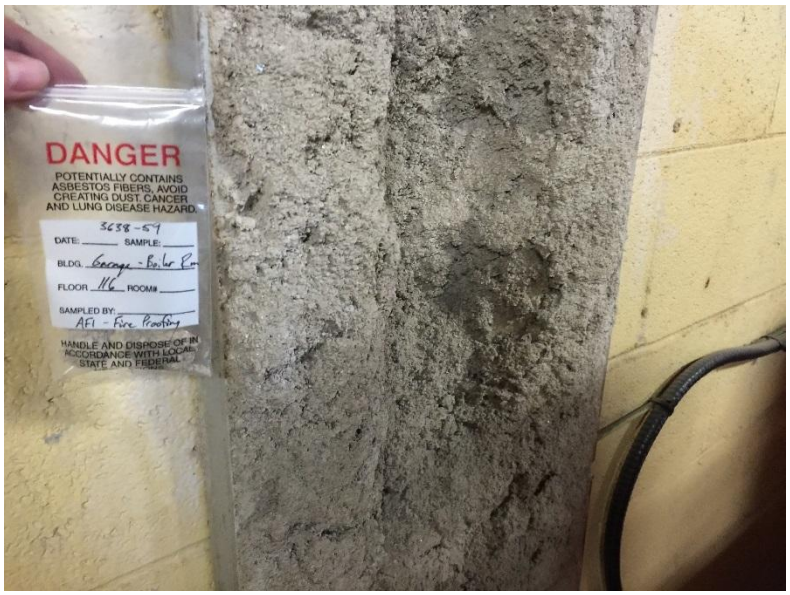


Photo 72

Sample 3638-59, fire proofing collected from 116 – Asbestos negative

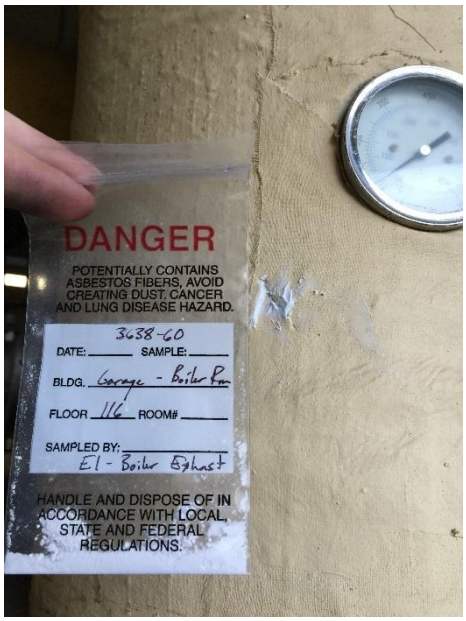


Photo 73

Sample 3638-60, insulation collected from 116 – Asbestos negative

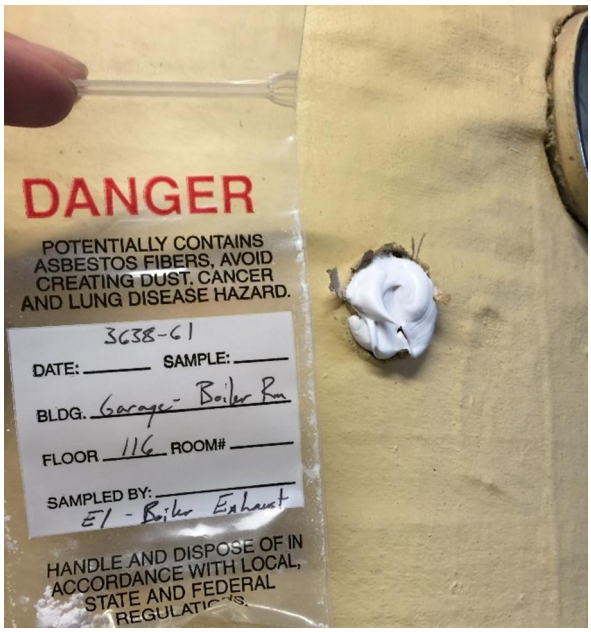


Photo 74

Sample 3638-61, insulation collected from 116 – Asbestos negative

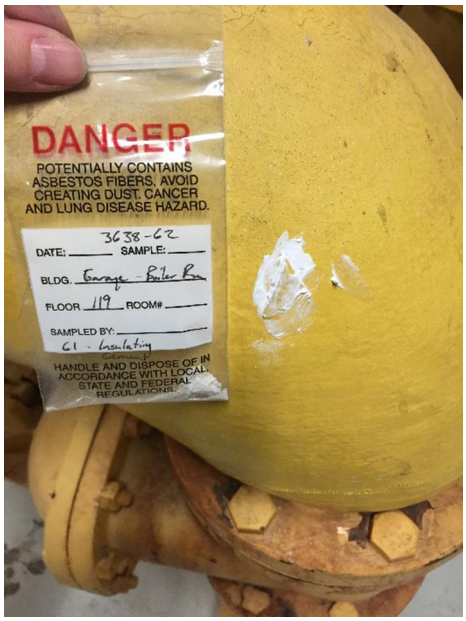


Photo 75

Sample 3638-62, insulating cement collected from 119 – Asbestos negative

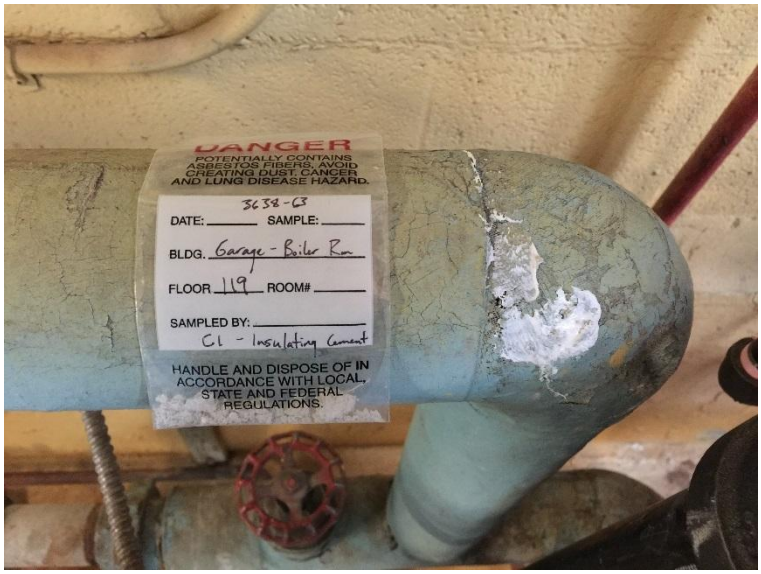


Photo 76

Sample 3638-63, insulating cement collected from 119 – Asbestos positive

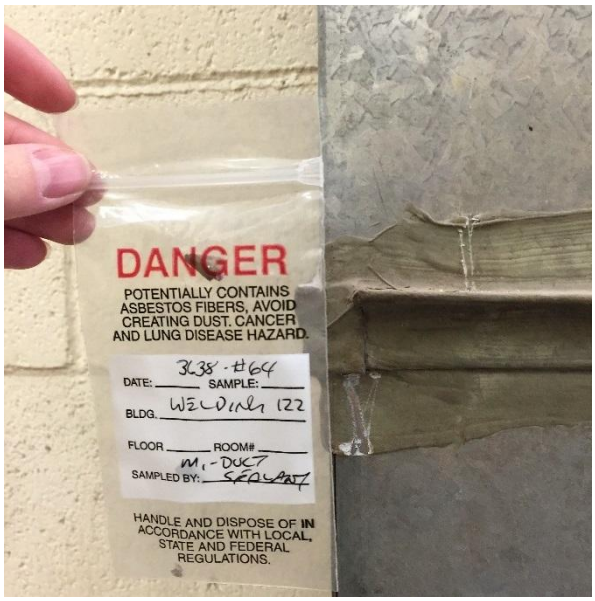


Photo 77

Sample 3638-64, duct sealant collected from 122 – Asbestos negative

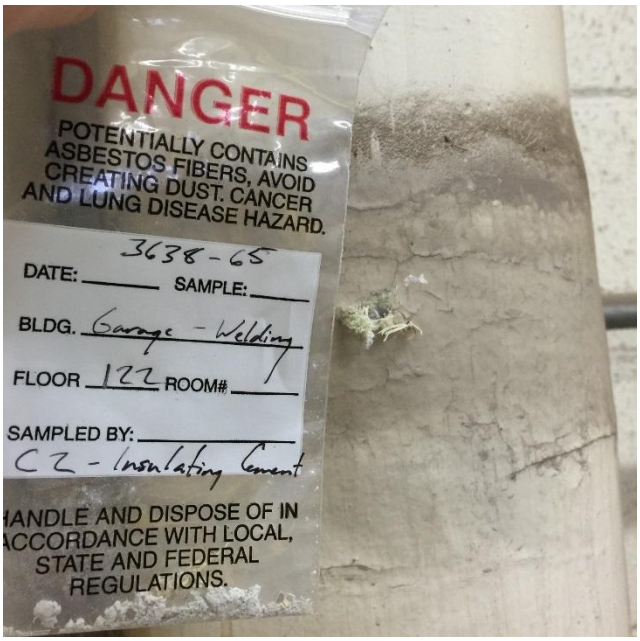


Photo 78

Sample 3638-65, insulating cement collected from 122 – Asbestos positive

Photo 79

Sample 3638-66, cement collected from SE exterior corner – Asbestos negative

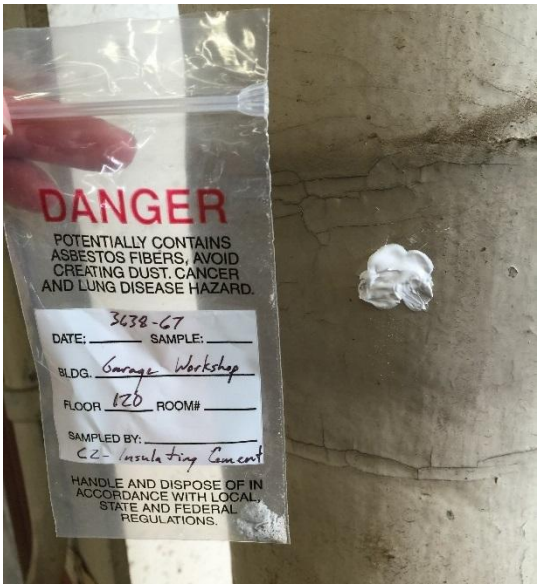


Photo 80

Sample 3638-67, insulating cement collected from 120 – Asbestos positive

Photo 81

Sample 3638-68, sealant collected from roof – Asbestos negative

Photo 82

Sample 3638-69, tar pot collected from roof – Asbestos negative

Photo 83

Sample 3638-70, flashing tar collected from roof – Asbestos positive

Photo 84

Sample 3638-71, duct sealant collected from roof – Asbestos negative

Photo 85

Sample 3638-72, duct sealant collected from roof – Asbestos negative

Photo 86

Sample 3638-73, sealant collected from roof – Asbestos negative

Photo 87

Sample 3638-74, stucco collected from roof – Asbestos negative

Photo 88

Sample 3638-75, roofing from garage roof – Asbestos negative

Photo 89

Sample 3638-76, window putty collected from roof – Asbestos negative

Photo 90

Sample 3638-77, black sealant collected from roof – Asbestos negative

Photo 91

Sample 3638-78, grey sealant collected from roof – Asbestos positive

Photo 92

Sample 3638-79, grey sealant collected from roof – Asbestos positive

Photo 93

Sample 3638-80, tar pot collected from roof – Asbestos negative

Photo 94

Sample 3638-81, roofing felt collected from roof – Asbestos negative

Photo 95

Sample 3638-82, sealant collected from roof – Asbestos negative

Photo 96

Sample LBP #2, White on block wall from A108 – Lead negative

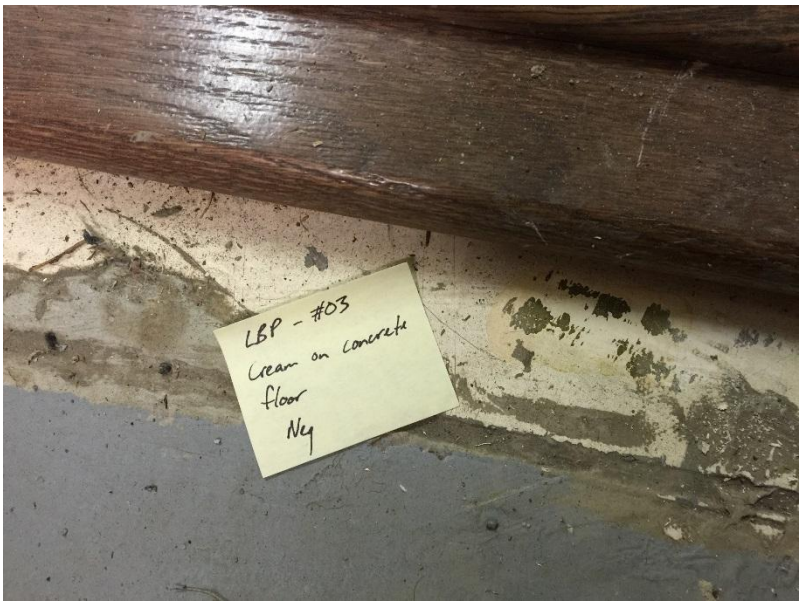


Photo 97

Sample LBP #3, Cream on concrete floor from A019 – Lead negative

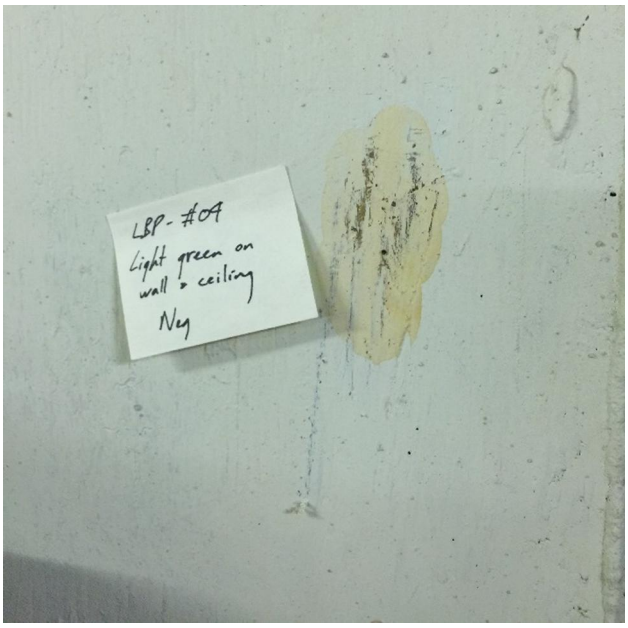


Photo 98

Sample LBP #4, light green on wall and ceiling from A006 – Lead negative

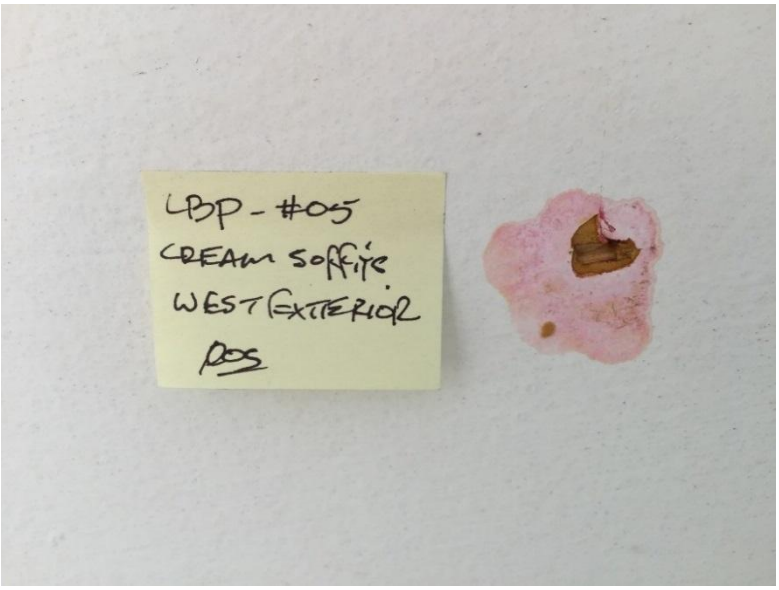


Photo 99

Sample LBP #5, Cream soffits west exterior from West Exterior – Lead positive

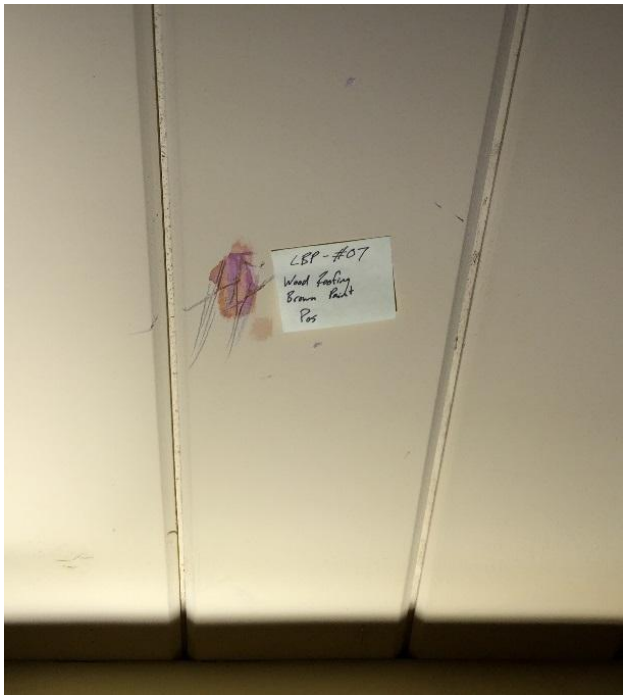


Photo 100

Sample LBP #07, wood roofing brown paint from A165 – Lead positive

Photo 101

Sample LBP #09, light brown on brick wall from A154 – Lead negative

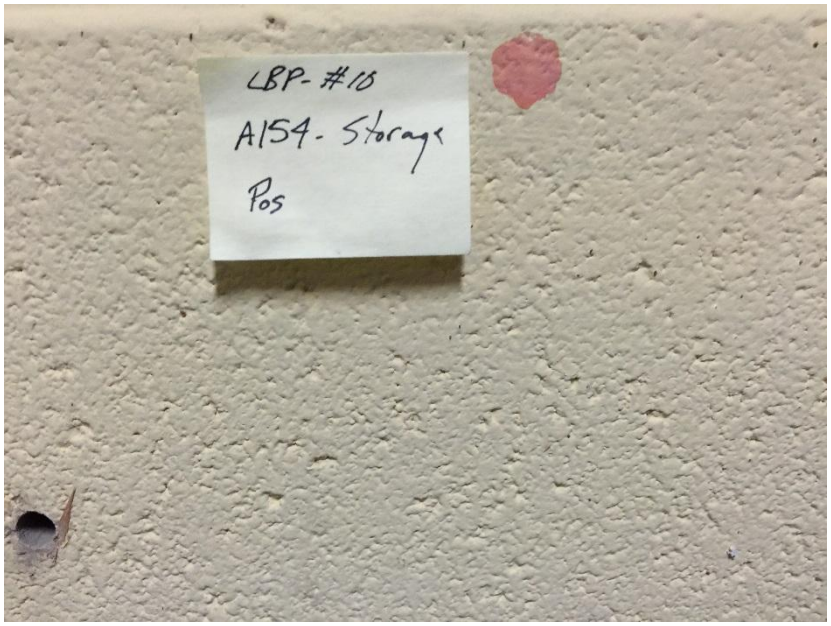


Photo 102

Sample LBP #10, cream/beige on brick wall from A154 – Lead positive

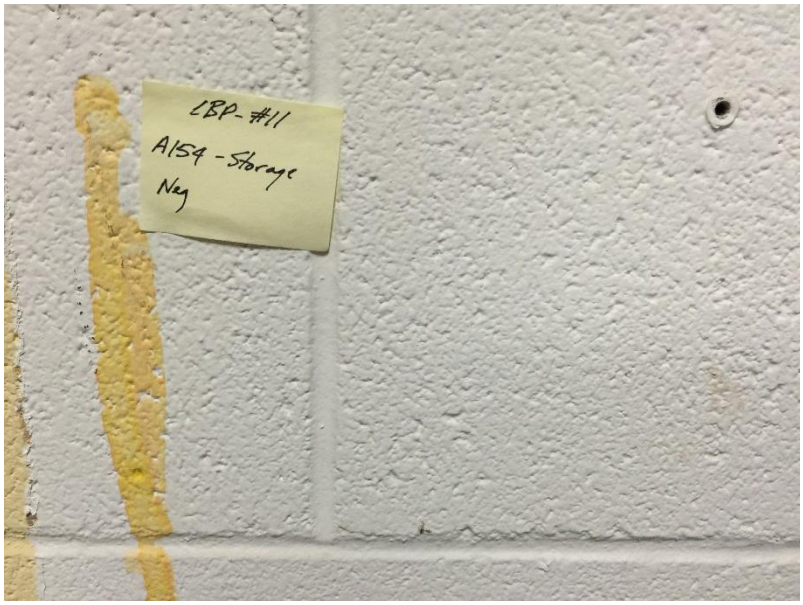


Photo 103

Sample LBP #11, white on brick wall from A154 – Lead negative

Photo 104

Sample LBP #02, cream on wood ship lap ceiling from 119 (Garage) – Lead positive

Photo 105

Sample LBP #03, red oxide primer under cream paint from 119 (Garage) – Lead positive

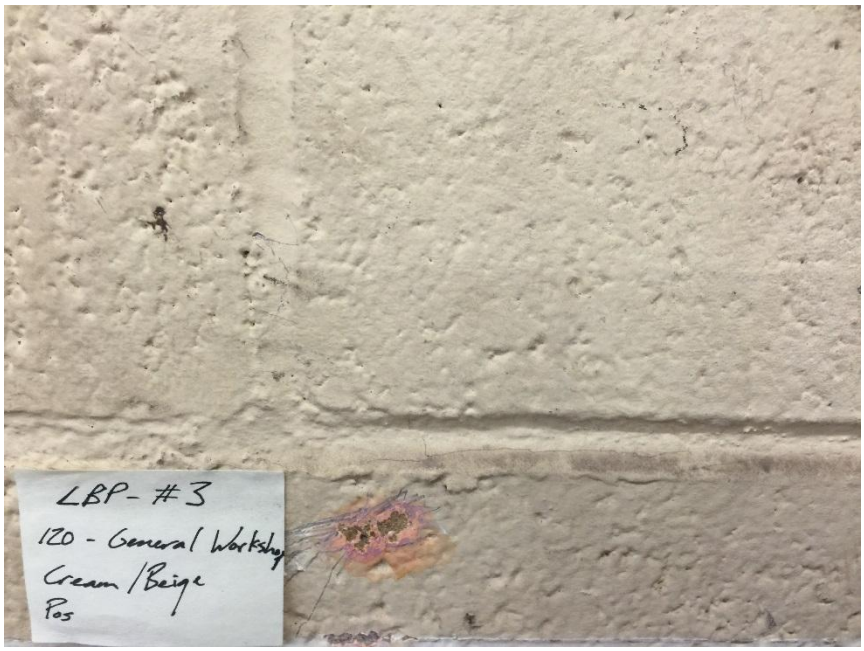


Photo 106

Sample LBP #03, cream/beige from 120 (Garage) – Lead positive

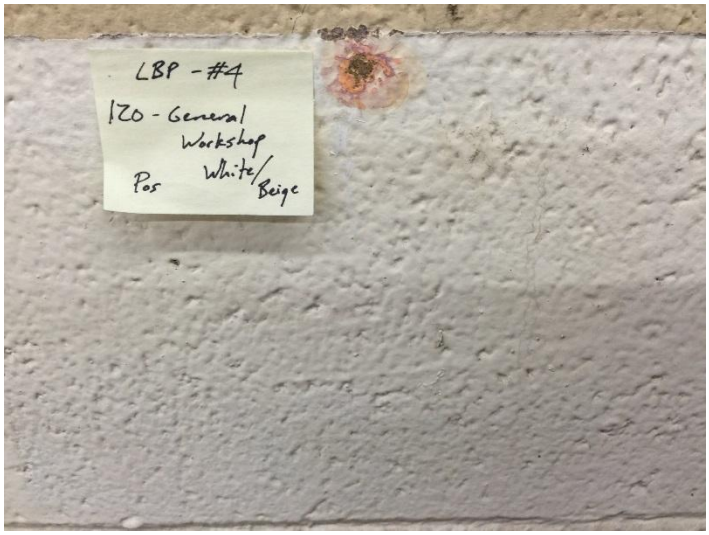


Photo 107

Sample LBP #04, white/beige paint from 120 (Garage) – Lead positive

Photo 108

Refractory cement on boiler segments

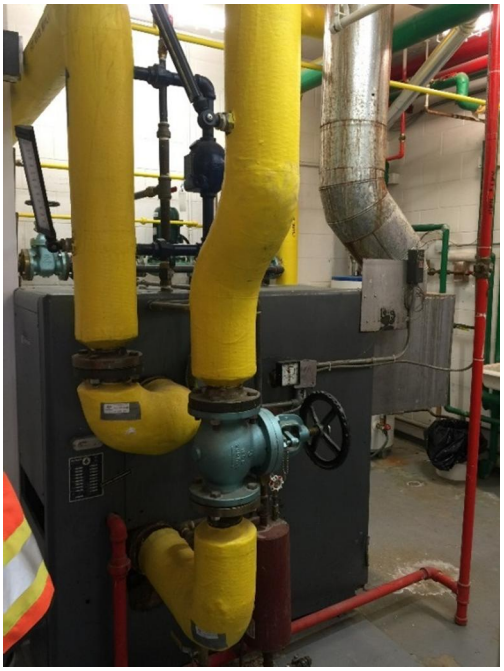


Photo 109

Boiler exhaust “B” vent through ceiling (suspect)

Photo 110

Segmented cube boiler

Photo 111

Ceiling panel (suspect)

Photo 112

Bell and spigot packing

Photo 113

Boiler refractory cement (suspect)

Appendix D - Health and Safety Forms

Associated Environmental

Job Safety Plan

Project Name & Number	Banff Operations Compound 2016-3790.100		
Client	Parks Canada	Client (Person)	Laurie MacDonald
		Client (Phone)	403-431-2168
Date Created	September 16, 2016	Revision Date	

Crew

Field Crew (list members, highlight the leader): Andrea Ellis

Contractor(s): Peak Environmental
Contractor Staff: Steve Ferguson

All workers on the Work Site must have easy access to project safety documents including the *Job Safety Plan*, *Tailgate Meeting records*, and all applicable *Safe Work Practices/Procedures*. If a single location does not provide such access to all persons on the Work Site, an adequate number of copies must be made.

Check In Information

Check-In Person	Rebekka Lindskoog	Responsible Person	Rebekka Lindskoog
Contact Info	250-938-5528	Contact Info	
Group Manager	Rebekka Lindskoog	Safety Coordinator	Sid Kwakkel
Contact Info	250-938-5528	Contact Info	250-938-1519

First Aid Resources

Low Risk: e.g. Meeting at a client's office, no field work
Medium Risk: e.g. Normal environmental field work
High Risk: High risk activities are listed by every jurisdiction. For more information, consult the Safety Coordinator.

Choose One:

☐ ***Low Risk***
First Aid Kit: 1 required

☒ ***Medium Risk, Crew of 1***
First Aid Kit: *1 required*

☐ ***Medium Risk, Crew of 2-9***
First Aid Attendant:
First Aid Kit(s): *1 required*

☐ ***Medium Risk, Crew of 10 or more***
First Aid Attendant # 1:
First Aid Attendant # 2:
First Aid Kit(s): *2 required*

For sites >20 minutes from medical care (e.g. hospital),
☐ In BC, YT, 3 blankets required for crews of 2-5 people.
☐ In AB, NT, and SK: 3 blankets required for crews of 2-9 people.

Required Personal Protective Equipment

Indicate the PPE required on the job site, and give a description

☒ Head	Hard hat	☒ Foot	Steel toe boots
☒ Eyes / Face	Safety glasses	☒ High Visibility	
☒ Respiratory	Respirator	☐ Other	

Review & Sign-Off

Prepared by	Rebekka Lindskoog	Project Manager	Joseph Chen
Signature		Signature	
Group Manager	Rebekka Lindskoog		
Signature			

Associated Environmental

Job Safety Plan

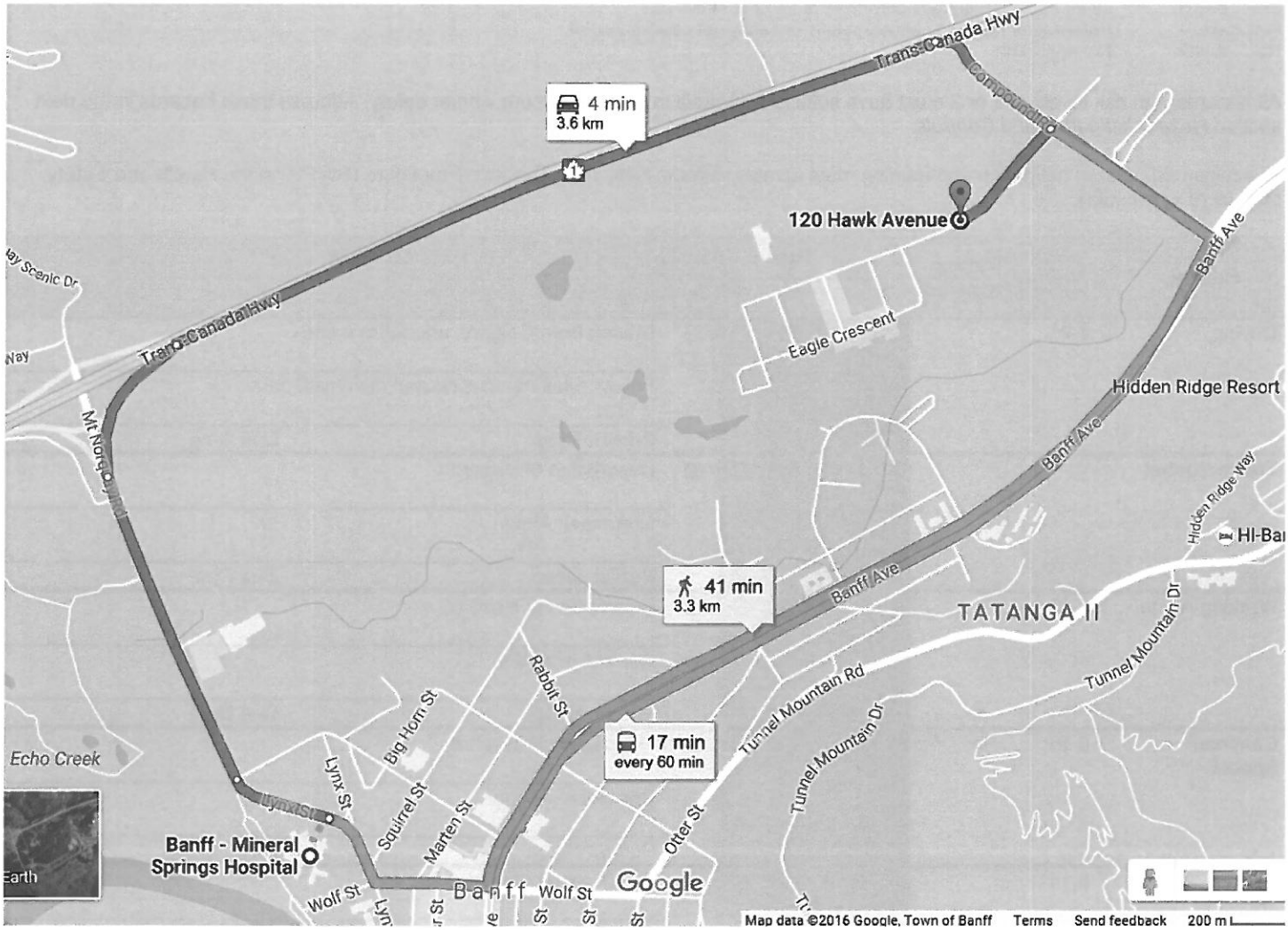
Site Address 120 Hawk Avenue
Latitude _____ Longitude _____
UTM _____
Northing Easting Zone

Work Site Plan

Draw or Copy/Paste map
Indicate muster point, hazards, and other important features

Nearest Hospital or First Aid Station

Draw or copy/paste map with directions



Hazard Identification & Mitigation

Risk Level 1: Hazard is stopping work, requires control to be in place before continuing
Risk Level 2: Serious hazard, requires extra vigilance by workers, but not stopping work
Risk Level 3: Minor hazard, requires notifying workers of potential risk
Risk Level 4: Potential for hazard to appear, but is currently not a factor in work
Risk Level 5: Not applicable

All hazards with risk levels of 1 or 2 must have sufficient controls in place to ensure worker safety. Address these hazards in the next section *Hazard Mitigation and Controls*.

At a minimum, hazard mitigation and training must comply with the Safe Work Practice/Procedure (SWPP) in the Health and Safety Manual (if applicable).

Hazard	SWPP	Training Required	Risk 1	Risk 2	Risk 3	Risk 4	Risk 5	
Driving	7.8.21	✓	☐	☐	☒	☐	☐	Driving from Calgary, and to/from site Follow rules of the road and drive with care Person Resp. Due Date
Traffic Control			☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Working Alone	7.8.0		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Confined Spaces	7.8.16		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Gases	7.8.14		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Hydrogen Sulfide (H2S)	7.8.15	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Ground disturbance	7.8.17	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Utilities	7.8.18		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date

Job Safety Plan

Hazard	SWPP	Training Required	Risk 1	Risk 2	Risk 3	Risk 4	Risk 5	
Wildlife	7.8.9	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Moving water	7.8.5	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Heat Stress	7.8.8		☐	☐	☐	☒	☐	Boiler room may be warm conditions for working Dress in layers, drink plenty of water Person Resp. Due Date
Cold Stress	7.8.8		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Working on ice	7.8.6		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Avalanche	7.8.7	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Snowmobile	7.8.26		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
All terrain vehicle (ATV)	7.8.22		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Hills, slopes, and cliffs	7.8.12		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Fall protection	7.8.4		☐	☐	☐	☒	☐	May be overhead pipes Watch where walking/working. Person Resp. Due Date

Associated Environmental

Job Safety Plan

Hazard	SWPP	Training Required	Risk 1	Risk 2	Risk 3	Risk 4	Risk 5	
Rigging	7.8.19		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Helicopter	7.8.10		☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Boat	7.8.23	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Power / chain saw	7.8.24	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Electrofishing	7.8.25	✓	☐	☐	☐	☐	☒	Description of Hazard Corrective Action Person Resp. Due Date
Slips and Trips			☐	☐	☐	☒	☐	Floor in mechanical room may be slippery Be careful, watch where walking. Person Resp. Due Date
Manual lifting, crouching			☐	☐	☐	☒	☐	Lifting coolers, tools for sampling, crouching for sampling Follow best lifting procedures. Lift with legs. Do not crouch for long periods. Person Resp. Due Date
			☐	☐	☐	☐	☐	Description of Hazard Corrective Action Person Resp. Due Date
			☐	☐	☐	☐	☐	Description of Hazard Corrective Action Person Resp. Due Date
			☐	☐	☐	☐	☐	Description of Hazard Corrective Action Person Resp. Due Date

Work Plan

Identify the worker roles and describe the hazards that are particular to that role. Add/remove rows as needed.

Role: Field sampling
Worker(s): Andrea Ellis
Hazards:

Role: Field sampling
Worker(s): Steve Ferguson
Hazards:

Role:
Worker(s):
Hazards:

Role:
Worker(s):
Hazards:

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Worker(s):
Hazards:

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Worker(s):
Hazards:

Role:
Worker(s):
Hazards:

Ground Disturbance Emergency Contacts

Call Before You Dig

AB	1-800-242-3447
BC	1-800-474-6886
SASK	1-866-828-4888
YK	1-800-661-0513 (ATCO Electric)
	1-888-768-5377 (NorthwesTel)
	+ Local Municipality
NWT	1-867-587-7015

Gas Line Leaks or Breaks

AB	9-1-1
BC	1-800-663-9911
SASK	9-1-1
YK	Local emergency dispatch
NWT	Local emergency dispatch

Electrical Emergencies

AB	9-1-1
BC	1-888-769-3766
SASK	9-1-1
YK	Local emergency dispatch
NWT	Local emergency dispatch

Fire Prevention

Wild Fires

1-800-663-5555 (*5555 on the cell phones)

Associated Environmental Office Contacts

Burnaby	(604) 293-1411
Calgary	(403) 262-4500
Edmonton	(780) 451-7666
Regina	(306) 721-2466
Saskatoon	(306) 653-4969
Vernon	(250) 545-3672
Whitehorse	(867) 456-2711
Yellowknife	(867) 920-4074

Associated Environmental

Tailgate Safety Meeting Record

Template Revision Date
January 2016
Systems Manager

Project Name & Number 2016-3790.100

Crew Size 2 Date

TAILGATE MEETING AGENDA

Job Safety Plan Reviewed (check sections reviewed)

Work Plan	☒	Emergency Plan	☒
Hazard Assessment	☒	Safety Communication	☒
Mitigative Measures	☒	First Aid	☒
Check-In Information	☒	Training Requirements	☐
Personal Protective Equipment	☒		

Job Safety Plan Amendments / Changing Site Conditions

Amendment / Changing Hazard	Corrective Action / Control
N/A	

I understand and agree to abide by to the requirements of Associated Environmental's Health and Safety Program, Environmental Management Policy, and WCB regulations as they apply to the above noted works.

Name:	Steve Ferguson	Company:	KEAG Environmental	Signed:		Date:	9/23/16
Name:		Company:		Signed:		Date:	
Name:		Company:		Signed:		Date:	
Name:	Andrew Ellis	Company:	AE	Signed:		Date:	9/23/16
Name:		Company:		Signed:		Date:	
Name:		Company:		Signed:		Date:	

Appendix E - Laboratory Reports

TSS PACIFIC - RECORD OF ANALYSIS

Report Number:	10427-54786	**Reference:**	3638 #1-45, 76-82
Client:	Peak Environmental	**Report Date:**	12-Oct-16
Address:	Parks Canada Banff - TECH / WARDEN BUILDING Banff Alberta	**Contact:**	Steve Ferguson

Please find enclosed our laboratory's results for the bulk sample(s) submitted to our office for identification.

Sample examination was conducted in accordance with the NIOSH 9002 analytical method using polarized light microscopy and dispersion staining techniques.

A result of 'Asbestos–Not detected' means no asbestos fibres were detected. When asbestos is detected, the minimum quantitation limit is 1%. Levels of asbestos present but below 1% based on visual estimation will be described as TRACE.

This test report relates only to the items tested and any extrapolation by the client of the results is the responsibility of the client. For samples not collected by TSS Pacific, the accuracy of locations and material(s) is the responsibility of the client. Samples will be disposed of after one month, unless we are instructed otherwise.

If asbestos products are identified in this report they should be remediated safely in accordance with the requirements of Part 6.0 of the Worksafe B.C. Occupational Health and Safety Regulation. In general this will require the completion of a Risk Assessment (Part 6.6.1) completed by a "Qualified Person" as defined in Part 6.1.

TSS PACIFIC - RECORD OF ANALYSIS

Report Number: 10427-54786

Client Name: Peak Environmental
Reference: 3638 #1-45, 76-82
Amended Report: 12-Oct-16

Address: Parks Canada Banff, Banff
Sampled By: Peak Environmental
Date Sampled: 30-Sep-16
Date Analyzed: 06-Oct-16
Analyst: EC

NO.	SAMPLE INFORMATION	LAYER	ASBESTOS	OTHER MATERIALS
10427-54786-001	Vinyl Floor Tile 3638-01 Tech / Warden Building / Corridor A013A	Hard white vinyl 98% Black mastic 2%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-002	Duct Sealant 3638-02 Tech / Warden Building / Corridor A013	White paint 40% Brown sealant 60%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 95%, Synthetic 5%
10427-54786-003	Drywall Joint Compound 3638-03 Tech / Warden Building / Corridor A013A	White paint 20% White chalky mix 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-004	Insulating Cement 3638-04 Tech / Warden Building / Corridor A013 On hot water pipe fitting	Beige mix 100%	Not Detected	Non-Fibrous 85%, Fibreglass 10%, Cellulose 5%
10427-54786-005	Drywall Joint Compound 3638-05 Tech / Warden Building / Corridor A013C	White chalky mix 100%	Not Detected	Non-Fibrous 100%
10427-54786-006	Duct Sealant 3638-06 Tech / Warden Building / Storage A006	Brown sealant 100%	Not Detected	Non-Fibrous 100%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-007	Drywall Joint Compound 3638-07 Tech / Warden Building / Corridor A002	White chalky mix 100%	Not Detected	Non-Fibrous 100%
10427-54786-008	Vinyl Floor Tile 3638-08 Tech / Warden Building / Storage A010	Hard white vinyl 95% Black mastic 5%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-009	Window Putty 3638-09 Tech / Warden Building / Corridor A013C	Soft grey layer 100%	YES - Chrysotile 2%	Non-Fibrous 98%
10427-54786-010	Vinyl Floor Tile 3638-10 Tech / Warden Building / Office A007	Hard white vinyl 100%	Not Detected	Non-Fibrous 100%
10427-54786-011	Mastic 3638-11 Tech / Warden Building / Storage A021 On concrete foundation wall	White foam 10% Black mastic 90%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-012	Duct Sealant 3638-12 Tech / Warden Building / Storage A021	Brown sealant 30% Grey layer 70%	Not Detected Not Detected	Non-Fibrous 99%, Synthetic 1% Non-Fibrous 100%
10427-54786-013	Vinyl Floor Tile 3638-13 Tech / Warden Building / Corridor B116A	Hard white vinyl 100%	YES - Chrysotile 1%	Non-Fibrous 99%
10427-54786-014	Ceiling Tile 3638-14 Tech / Warden Building / General assembly B102	White paint 10% Beige fibrous layer 90%	Not Detected Not Detected	Non-Fibrous 100% Fibreglass 70%, Cellulose 20%, Non-Fibrous 10%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-015	Duct Sealant 3638-15 Tech / Warden Building / General assembly B102	Grey sprakling layer 100%	YES - Chrysotile 5%	Non-Fibrous 95%
10427-54786-016	Drywall Joint Compound 3638-16 Tech / Warden Building / Office B106	White paint 20% White chalky mix 60% Paper 20%	Not Detected YES - Chrysotile 1% Not Detected	Non-Fibrous 100% Non-Fibrous 99% Cellulose 100%
10427-54786-017	Vinyl Floor Tile 3638-17 Tech / Warden Building / Office B108	Hard white vinyl 100%	Not Detected	Non-Fibrous 100%
10427-54786-018	Vinyl Floor Tile 3638-18 Tech / Warden Building / Office B104	Hard white vinyl 100%	Not Detected	Non-Fibrous 100%
10427-54786-019	Sealant 3638-19 Tech / Warden Building / West exterior Window panel	Soft grey layer 100%	YES - Chrysotile 5%	Non-Fibrous 95%
10427-54786-020	Insulating Cement 3638-20 Tech / Warden Building / Washroom B142 On hot water pipe fitting	Grey fibrous layer 100%	YES - Chrysotile 40%	Non-Fibrous 60%
10427-54786-021	Drywall Joint Compound 3638-21 Tech / Warden Building / Radio room B117	Yellow paint 20% Grey chalky mix 80%	Not Detected YES - Chrysotile 1%	Non-Fibrous 100% Non-Fibrous 99%
10427-54786-022	Window Putty 3638-22 Tech / Warden Building / Radio room B117 Exterior window	Soft grey layer 100%	YES - Chrysotile 5%	Non-Fibrous 95%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-023	Duct Sealant 3638-23 Tech / Warden Building / Lunch room B120	White paint 20% Grey layer 80%	Not Detected YES - Chrysotile 5%	Non-Fibrous 100% Non-Fibrous 95%
10427-54786-024	Insulating Cement 3638-24 Tech / Warden Building / Office B122 On hot water pipe fitting	White paint 20% Grey fibrous layer 80%	Not Detected YES - Chrysotile 40%	Non-Fibrous 100% Non-Fibrous 60%
10427-54786-025	Not Specified 3638-25 Tech / Warden Building / Boiler room 138 Boiler exhaust breaching	Grey fibrous layer 100%	YES - Chrysotile 40%	Non-Fibrous 60%
10427-54786-026	Insulating Cement 3638-26 Tech / Warden Building / Boiler room B138 On hot water pipe fitting	White paint 5% Grey fibrous layer 85% Yellow fibrous layer 10%	Not Detected YES - Chrysotile 40% Not Detected	Non-Fibrous 100% Non-Fibrous 60% Fibreglass 100%
10427-54786-027	Sheet Vinyl Flooring 3638-27 Tech / Warden Building / Shower room B139	White vinyl sheet 30% Foam core 70%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-028	Duct Sealant 3638-28 Tech / Warden Building / Wood shop B128	White paint 20% Grey layer 80%	Not Detected YES - Chrysotile 5%	Non-Fibrous 100% Non-Fibrous 95%
10427-54786-029	Drywall Joint Compound 3638-29 Tech / Warden Building / Wood shop B128	White paint 20% White chalky mix 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-030	Insulating Cement 3638-30 Tech / Warden Building / Room B137 On hot water pipe fitting	Grey fibrous layer 100%	YES - Chrysotile 30%	Non-Fibrous 70%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-031	Duct Sealant 3638-31 Tech / Warden Building / Vestibule A165	Brown layer 100%	Not Detected	Non-Fibrous 100%
10427-54786-032	Vinyl Floor Tile 3638-32 Tech / Warden Building / Office A163	Hard white vinyl 100%	Not Detected	Non-Fibrous 100%
10427-54786-033	Duct Sealant 3638-33 Tech / Warden Building / Corridor A146	Brown layer 100%	Not Detected	Non-Fibrous 100%
10427-54786-034	Insulating Cement 3638-34 Tech / Warden Building / Corridor A146 On hot water pipe fitting	Beige fibrous layer 100%	Not Detected	Non-Fibrous 75%, Cellulose 20%, Fibreglass 5%
10427-54786-035	Refractory Cement 3638-35 Tech / Warden Building / Boiler room A106 On top of boiler segments	Grey cementitious mix 100%	YES - Chrysotile 5%	Non-Fibrous 95%
10427-54786-036	Insulating Cement 3638-36 Tech / Warden Building / Boiler room A106 On domestic cold water pipe fitting	Beige fibrous layer 100%	Not Detected	Non-Fibrous 70%, Cellulose 20%, Fibreglass 10%
10427-54786-037	Pipe Gasket 3638-37 Tech / Warden Building / Boiler room A106	Grey fibrous layer 100%	Not Detected	Non-Fibrous 70%, Synthetic 30%
10427-54786-038	Insulating Cement 3638-38 Tech / Warden Building / Boiler room A106 On hot water pipe fitting	Paper 10% Grey fibrous layer 90%	Not Detected Not Detected	Cellulose 100% Non-Fibrous 60%, Cellulose 30%, Fibreglass 10%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-039	Not Specified 3638-39 Tech / Warden Building / Electrical room A107 Fibre gum on electrical penetration	Soft green layer 100%	Not Detected	Non-Fibrous 70%, Cellulose 30%
10427-54786-040	Not Specified 3638-40 Tech / Warden Building / Electrical room A107 Fibre gum on electrical penetration	Soft red layer 100%	Not Detected	Non-Fibrous 80%, Synthetic 20%
10427-54786-041	Window Putty 3638-41 Tech / Warden Building / Office A143 Interior window	Soft black layer 100%	Not Detected	Non-Fibrous 95%, Cellulose 5%
10427-54786-042	Drywall Joint Compound 3638-42 Tech / Warden Building / Entry A112	Brown paint 20% White chalky mix 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-043	Drywall Joint Compound 3638-43 Tech / Warden Building / Storage A127	White chalky mix 80% Paper 20%	Not Detected Not Detected	Non-Fibrous 100% Cellulose 100%
10427-54786-044	Vinyl Floor Tile 3638-44 Tech / Warden Building / Storage A127	Hard white vinyl 100%	Not Detected	Non-Fibrous 100%
10427-54786-045	Duct Sealant 3638-45 Tech / Warden Building / Storage A127	White paint 20% Brown layer 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-076	Window Putty 3638-76 Tech / Warden building / Roof	Black layer 100%	Not Detected	Non-Fibrous 100%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-077	Sealant 3638-77 Tech / Warden building / Roof	Black layer 100%	Not Detected	Non-Fibrous 99%, Fibreglass 1%
10427-54786-078	Sealant 3638-78 Tech / Warden building / Roof	Grey sparkling layer 100%	YES - Chrysotile 1%	Non-Fibrous 99%
10427-54786-079	Sealant 3638-79 Tech / Warden building / Roof AHU (HV-2) electrical penetration	Black layer 100%	YES - Chrysotile 8%	Non-Fibrous 92%
10427-54786-080	Tar 3638-80 Tech / Warden building / Roof AHU gas penetration	Black layer 100%	Not Detected	Non-Fibrous 95%, Cellulose 5%
10427-54786-081	Roofing 3638-81 Tech / Warden building / Roof	White pebble layer 20% Black fibrous tar 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 80%, Cellulose 20%
10427-54786-082	Membrane 3638-82 Tech / Warden building / Roof	Black fibrous tar 100%	Not Detected	Non-Fibrous 80%, Cellulose 18%, Fibreglass 2%

Total Number of Samples: 52

Report Reviewed By: Elizabeth Camacho

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

1

TSS PACIFIC - RECORD OF ANALYSIS

Report Number:	10427-54786	**Reference:**	3638 #46-75
Client:	Peak Environmental	**Report Date:**	12-Oct-16
Address:	Parks Canada Banff - GARAGE BUILDING Banff Alberta	**Contact:**	Steve Ferguson

Please find enclosed our laboratory's results for the bulk sample(s) submitted to our office for identification.

Sample examination was conducted in accordance with the NIOSH 9002 analytical method using polarized light microscopy and dispersion staining techniques.

A result of 'Asbestos–Not detected' means no asbestos fibres were detected. When asbestos is detected, the minimum quantitation limit is 1%. Levels of asbestos present but below 1% based on visual estimation will be described as TRACE.

This test report relates only to the items tested and any extrapolation by the client of the results is the responsibility of the client. For samples not collected by TSS Pacific, the accuracy of locations and material(s) is the responsibility of the client. Samples will be disposed of after one month, unless we are instructed otherwise.

If asbestos products are identified in this report they should be remediated safely in accordance with the requirements of Part 6.0 of the Worksafe B.C. Occupational Health and Safety Regulation. In general this will require the completion of a Risk Assessment (Part 6.6.1) completed by a "Qualified Person" as defined in Part 6.1.

TSS PACIFIC - RECORD OF ANALYSIS

Report Number: 10427-54786

Client Name: Peak Environmental
Reference: 3638 #46-75
Amended Report: 12-Oct-16

Address: Parks Canada Banff, Banff
Sampled By: Peak Environmental
Date Sampled: 30-Sep-16
Date Analyzed: 06-Oct-16
Analyst: EC

NO.	SAMPLE INFORMATION	LAYER	ASBESTOS	OTHER MATERIALS
10427-54786-046	Duct Sealant 3638-46 Garage building / Corridor 101	White paint 20% Grey layer 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-047	Insulating Cement 3638-47 Garage building / Corridor 101 On hot water pipe fitting	White paint 20% White mesh 10% White fibrous layer 70%	Not Detected Not Detected YES - Chrysotile 8%	Non-Fibrous 100% Cellulose 100% Fibreglass 60%, Non-Fibrous 32%
10427-54786-048	Vinyl Floor Tile 3638-48 Garage building / Lunch room 102	Hard beige vinyl 100%	YES - Chrysotile 2%	Non-Fibrous 98%
10427-54786-049	Window Putty 3638-49 Garage building / Lunch room 102	White mix 100%	Not Detected	Non-Fibrous 100%
10427-54786-050	Plaster 3638-50 Garage building / Changeroom 103	White paint 10% White chalky cement 20% White cement mix 70%	Not Detected Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100% Non-Fibrous 100%
10427-54786-051	Insulating Cement 3638-51 Garage building / Changeroom 103 ceiling space On hot water pipe fitting	White fibrous layer 100%	YES - Chrysotile 2%	Fibreglass 90%, Non-Fibrous 8%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-052 3	Plaster 3638-52 Garage building / Electrical room 115	White paint 10% White cement mix 90%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-053	Textured Ceiling 3638-53 Garage building / Reception 112	White paint 20% White chalky mix 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-054	Vinyl Floor Tile 3638-54 Garage building / Office 106	Hard white vinyl 100%	Not Detected	Non-Fibrous 100%
10427-54786-055	Fireproofing 3638-55 Garage building / Storage 119	White fibrous layer with mica 100%	Not Detected	Non-Fibrous 89%, Cellulose 10%, Fibreglass 1%
10427-54786-056	Fireproofing 3638-56 Garage building / Storage 119	White mix with mica 100%	Not Detected	Non-Fibrous 75%, Cellulose 20%, Fibreglass 5%
10427-54786-057	Fireproofing 3638-57 Garage building / Storage 117	Paint 10% White mix with mica 90%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 75%, Cellulose 20%, Fibreglass 5%
10427-54786-058	Refractory Cement 3638-58 Garage building / Boiler room 118	Paint 10% White cementitious mix 90%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-059	Fireproofing 3638-59 Garage building / Boiler room 118	White mix with mica 100%	Not Detected	Non-Fibrous 75%, Cellulose 20%, Fibreglass 5%
10427-54786-060	Insulation 3638-60 Garage building / Boiler room 118 Boiler exhaust breaching	White mix 100%	Not Detected	Non-Fibrous 95%, Synthetic 5%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-061	Insulation 3638-61 Garage building / Boiler room 118 Boiler exhaust breaching	White mix 100%	Not Detected	Non-Fibrous 100%
10427-54786-062	Insulating Cement 3638-62 Garage building / Boiler room 118 On hot water pipe fitting	White mix 100%	Not Detected	Non-Fibrous 80%, Cellulose 20%
10427-54786-063	Insulating Cement 3638-63 Garage building / Boiler room 118 On domestic cold water pipe fitting	White fibrous layer 100%	YES - Chrysotile 10%	Fibreglass 80%, Non-Fibrous 10%
10427-54786-064	Duct Sealant 3638-64 Garage building / Welding 122	Grey layer 100%	Not Detected	Non-Fibrous 100%
10427-54786-065	Insulating Cement 3638-65 Garage building / Welding 122 On rainwater leader pipe, fiberglass insulation joints, and roof drain bowels	Paint 10% White mesh 20% White fibrous layer 70%	Not Detected Not Detected YES - Chrysotile 30%	Non-Fibrous 100% Cellulose 100% Non-Fibrous 70%
10427-54786-066	Cement 3638-66 Garage building / Southeast exterior Lower concrete foundation wall	Grey cementitious mix 100%	Not Detected	Non-Fibrous 100%
10427-54786-067	Insulating Cement 3638-67 Garage building / General workshop 120 On rainwater leader pipe, fiberglass insulation joints, and roof drain bowels	White rope 10% White fibrous layer 90%	Not Detected YES - Chrysotile 30%	Cellulose 100% Non-Fibrous 70%
10427-54786-068	Sealant 3638-68 Garage building / Roof On boiler exhaust breeching	Black layer 100%	Not Detected	Non-Fibrous 100%

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

10427-54786-069 5	Tar 3638-69 Garage building / Roof Sealant on AHU penetrations	Black layer 100%	Not Detected	Non-Fibrous 92%, Cellulose 8%
10427-54786-070	Tar 3638-70 Garage building / Roof Flashing tar	White cementitious mix 10% Black layer 90%	Not Detected YES - Chrysotile 5%	Non-Fibrous 100% Non-Fibrous 94%, Cellulose 1%
10427-54786-071	Duct Sealant 3638-71 Garage building / Roof	Grey layer 100%	Not Detected	Non-Fibrous 100%
10427-54786-072	Duct Sealant 3638-72 Garage building / Roof Exhaust fans	Orange layer 100%	Not Detected	Non-Fibrous 95%, Synthetic 5%
10427-54786-073	Sealant 3638-73 Garage building / Roof Between window lintel stonework	Paint 10% Grey layer 90%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-074	Stucco 3638-74 Garage building / Roof	Paint 10% Grey cementitious mix 90%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 100%
10427-54786-075	Membrane 3638-75 Garage building / Roof	Grey pebble layer 20% Black fibrous tar 80%	Not Detected Not Detected	Non-Fibrous 100% Non-Fibrous 80%, Cellulose 20%

Total Number of Samples: 30

Report Reviewed By: Elizabeth Camacho

Analyzed in accordance with NIOSH METHOD 9002 – ASBESTOS (BULK) BY PLM

iPad 10:14 PM 41%

3638 ANC01 - Banff Mtc Compound

Home Insert Draw Formulas Review View

Formula Bar More Options Freeze Panes

fx ASBESTOS: FUNGAL:

TSS # sample # same as Peak # ☺ (samples not totally in order on coc)

	A	B	C	D	E	F	G	H
1	PACIFIC PROJECT # 10427					CONTACT NAME:	Steve Ferguson steve@peakenvironmental.ca	
2	CLIENT:	Peak Environmental Ltd.				PROJECT ADDRESS:	Parks Canada Banff Garage Building	
3	DATE SAMPLED:					REPORT RESULTS BY:	ASBESTOS:	FUNGAL:
4	COLLECTED BY:	☑ steve@peakenvironmental.ca	☐ doug@peakenvironmental.ca			TELEPHONE ☐	REGULAR (5-DAY) ☑	REGULAR (3-DAY) ☐
5		☐ nicole@peakenvironmental.ca	☐ tim@peakenvironmental.ca			FAX ☐	NEXT DAY RUSH ☐	NEXT DAY RUSH ☐
		☐ kathy@peakenvironmental.ca	☐ fred@peakenvironmental.ca					
6	Approx. Age of Bldng:					EMAIL ☐	SAME DAY RUSH ☐	SAME DAY RUSH ☐
7							SPECIAL INSTRUCTIONS:	
8	All asbestos samples are analyzed in accordance with the National Institute for Occupational Safety and Health (NIOSH) Analytical Method #9002, "Asbestos (bulk) by Polarized Light Microscopy."							

11	SAMPLE NO.	Floor	LOCATION / ROOM	SAMPLE TYPE OR MATERIAL	Air Vol (L)	NOTES
13	3638-46		Grey high velocity duct joint sealant - Corridor 101	duct sealant		
14	3638-47		Beige non-fibreious insulating cement on hot water pipe fitting - Corridor 101	insulation		
15	3638-48		12x12" Tan with brown and white streaked VFT - Lunch Room 102	floor tile		
16	3638-49		Hard white window putty - Lunch room 102	window putty		
17	3638-50		Finished plaster - Change room 103	plaster		
18	3638-51		Beige non-fibreious insulating cement on hot water pipe fitting - Change room 103 ceiling space	insulation		
19	3638-52		Finished plaster - Electrical room 115	plaster		
20	3638-53		Stipple ceiling texture - Reepetion 112	texture		
21	3638-54		12x12" Beige with brown and cream VFT - Office 106	floor tile		
22	3638-55		Cemetitious fireproofing - Storage 119	insulation		
23	3638-56		Cemetitious fireproofing - Storage 119	insulation		
24	3638-57		Cemetitious fireproofing - Storage 117	insulation		
25	3638-58		Boiler burner refractory cement - Boiler room 118	refractory cement		
26	3638-59		Cemetitious fireproofing - Boiler room 118	insulation		
27	3638-60		Boiler exhaust breaching insulation - Boiler room 118	insulation		
28	3638-61		Boiler exhaust breaching insulation - Boiler room 118	insulation		
29	3638-62		Beige non-fibreious insulating cement on hot water pipe fitting - Boiler room 118	insulation		
30	3638-63		Beige non-fibreious insulating cement on domestic cold water pipe fitting - Boiler room 118	insulation		
31	3638-64		Grey high velocity duct joint sealant - Welding 122	duct sealant		
32	3638-65		Hard beige insuleting cement on rainwater leader pipe Fiberglass insulation joints and roof drain bowels - Welding 122	insulation		
33	3638-66		Cement -arguing on lower concrete foundation wall - Southeast exterior	parging cement		
34	3638-67		Hard beige insulating cement on rainwater leader pipe Fiberglass insulation joints and roof drain bowels - General workshop 120	insulation		
35	3638-68		Black sealant on boiler exhaust breaching - Roof	sealant		
36	3638-69		Black tar pot sealant on AHU Penetrations - Roof	sealant		
37	3638-70		Black on grey flashing tar - Roof	sealant		

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TECH / WARDEN BUILDING	
12x12" Cream with long brown streaked VFT - Corridor A013A	3638-01
Red/Brown high velocity duct joint sealant - Corridor A013	3638-02
White drywall tape compound - Corridor A013A	3638-03
Beige non-fibrous insulating cement on hot water pipe fitting - Corridor A013	3638-04
White drywall tape compound - Corridor A013C	3638-05
Red/Brown high velocity duct joint sealant - Storage A006	3638-06
White drywall tape compound - Corridor A002	3638-07
12x12" Cream with long grey streaked VFT - Storage A010	3638-08
Soft grey interior window putty - Corridor A013C	3638-09
12x12" Cream beige and grey small splotched VFT - Office A007	3638-10
Black Styrofoam mastic glue on concrete foundation wall - Storage A021	3638-11
Grey high velocity duct joint sealant - Storage A021	3638-12
12x12" Tan with minimal brown streaked VFT - Corridor B116A	3638-13
2x4' Pinhole and textured tile - General Assembly B102	3638-14
Gold high velocity duct joint sealant - General Assembly B102	3638-15
Beige drywall tape compound - Office B106	3638-16
12x12" Beige brown and cream small splotched VFT - Office B108	3638-17
12x12" White with grey and light grey small splotched VFT - Office B104	3638-18
Grey window panel sealant - West exterior	3638-19
Beige non-fibrous insulating cement on hot water pipe fitting - Washroom B142	3638-20
Beige drywall tape compound - Radio room B117	3638-21
Soft grey exterior window putty - Radio room B117	3638-22
Grey high velocity duct joint sealant - Lunch room B120	3638-23
Beige non-fibrous insulating cement on hot water pipe fitting - Office B122	3638-24
Boiler exhaust breaching - Boiler room 138	3638-25
Beige non-fibrous insulating cement on hot water pipe fitting - Boiler room B138	3638-26
White and beige 2" square pattern VSF - Shower room B139	3638-27
Grey high velocity duct joint sealant - Wood Shop B128	3638-28
Beige drywall tape compound - Wood shop B128	3638-29
Beige non-fibrous insulating cement on hot water pipe fitting - Room B137	3638-30
Brown high velocity duct joint sealant - Vestibule A165	3638-31
12x12" White with grey, green and yellow splotched for VFT - Office A163	3638-32
Brown high velocity duct joint sealant - Corridor A146	3638-33

Beige non-fibrous insulating cement on hot water pipe fitting - Corridor A146	3638-34
Refractory cement on top of boiler segments - Boiler room A106	3638-35
Beige non-fibrous insulating cement on domestic cold water pipe fitting - Boiler room A106	3638-36
Pipe flange gaskets - Boiler room A106	3638-37
Beige non-fibrous insulating cement on hot water pipe fitting - Boiler room A106	3638-38
Grey fibre gum on electrical penetration - Electrical room A107	3638-39
Brown fibre gum on electrical penetration - Electrical room A107	3638-40
Soft black interior window putty - Office A143	3638-41
White drywall tape compound - Entry A112	3638-42
White drywall tape compound - Storage A127	3638-43
12x12" Cream with small' beige splotched VFT - Storage A127	3638-44
Brown high velocity duct joint sealant - Storage A127	3638-45
Soft black skylight window putty - Roof	3638-76
Black roof penetration sealant - Roof	3638-77
Grey roof penetration sealant - Roof	3638-78
Grey AHU (HV-2) electrical penetration sealant - Roof	3638-79
AHU gas penetration tar pot _ Roof	3638-80
Black roof penetration - Roof	3638-81
Torch on roof membrane - Roof	3638-82

GARAGE BUILDING	
Grey high velocity duct joint sealant - Corridor 101	3638-46
Beige non-fibrous insulating cement on hot water pipe fitting - Corridor 101	3638-47
12x12" Tan with brown and white streaked VFT - Lunch Room 102	3638-48
Hard white window putty - Lunch room 102	3638-49
Finished plaster - Change room 103	3638-50
Beige non-fibrous insulating cement on hot water pipe fitting - Change room 103 ceiling space	3638-51
Finished plaster - Electrical room 115	3638-52
Stipple ceiling texture - Reception 112	3638-53
12x12" Beige with brown and cream VFT - Office 106	3638-54
Cementitious fireproofing - Storage 119	3638-55
Cementitious fireproofing - Storage 119	3638-56
Cementitious fireproofing - Storage 117	3638-57
Boiler burner refractory cement - Boiler room 118	3638-58
Cementitious fireproofing - Boiler room 118	3638-59
Boiler exhaust breaching insulation - Boiler room 118	3638-60
Boiler exhaust breaching insulation - Boiler room 118	3638-61
Beige non-fibrous insulating cement on hot water pipe fitting - Boiler room 118	3638-62
Beige non-fibrous insulating cement on domestic cold water pipe fitting - Boiler room 118	3638-63
Grey high velocity duct joint sealant - Welding 122	3638-64
Hard beige insulating cement on rainwater leader pipe Fiberglass insulation joints and roof drain bowels - Welding 122	3638-65
Cement -arguing on lower concrete foundation wall - Southeast exterior	3638-66
Hard beige insulating cement on rainwater leader pipe Fiberglass insulation joints and roof drain bowels - General workshop 120	3638-67
Black sealant on boiler exhaust breaching - Roof	3638-68
Black tar pot sealant on AHU Penetrations - Roof	3638-69
Black on grey flashing tar - Roof	3638-70
Grey high velocity duct joint sealant - Roof	3638-71
Red exhaust fans duct joint sealant - Roof	3638-72
Grey sealant between window lintel stonework - Roof	3638-73
Exterior stucco - Roof	3638-74
Torch on roof membrane - Roof	3638-75

SECTION 02 26 23 – ASBESTOS AND LEAD BASED PAINT ABATEMENT

1 GENERAL

1.1 GENERAL INSTRUCTIONS

1.1.1 Asbestos-containing building materials and lead based paint applications have been identified within this facility as the following materials and applications:

TECH/ WARDEN BUILDING AREA 'A' DESIGNATION

- Asbestos in exterior window putties
- Asbestos in boiler packing and insulating materials
- Asbestos in cast iron bell and spigot joint packing
- Asbestos in vinyl floor tiles
- Asbestos in pipe flange gasketing materials
- Lead Based Paint - Cream on exterior wood soffits
- Lead Based Paint - Cream on white primer on wood ceiling ship lap
- Lead Based Paint - Red oxide primer on structural steel
- Lead Based Paint - Cream on concrete block walls (original colour)

TECH/ WARDEN BUILDING AREA 'B' DESIGNATION

- Asbestos in pipe flange gasketing materials
- Asbestos in boiler breaching insulation
- Asbestos in boiler packing and insulating materials
- Asbestos in cementitious pipe fitting insulation
- Asbestos in high velocity duct joint sealant
- Asbestos in drywall tape compound
- Asbestos in vinyl floor tiles
- Asbestos in cast iron bell and spigot joint packing
- Asbestos in various sealants and putties on the roof
- Lead Based Paint - Cream on exterior wood soffits
- Lead Based Paint - Cream on white primer on wood ceiling ship lap
- Lead Based Paint - Red oxide primer on structural steel
- Lead Based Paint - Cream on concrete block walls (original colour)

GARAGE BUILDING

- Asbestos in pipe flange gasketing materials
- Asbestos in cementitious pipe fitting insulation
- Asbestos in glue on glue up ceiling tiles
- Asbestos in cast iron bell and spigot joint packing
- Asbestos in boiler packing and insulating materials
- Asbestos in vinyl floor tiles
- Asbestos in flashing tar on the roof
- Red oxide primer under cream on structural steel
- Cream on wood ship lap ceiling
- Cream on concrete block walls
- White over cream on concrete block walls

1.1.2 It is the intention to safely remove all identified asbestos containing materials that will be directly in way of or that will be impacted through pending renovation work. A detailed hazardous materials assessment and inventory report is included in Section 02 26 00 showing the location of all known and suspect asbestos containing applications and confirmed lead based paint applications. The Prime Contractor and their sub-contractors will be required to familiarize themselves with known asbestos and lead applications in the facility and to identify where conflicts exist between asbestos materials and pending demotion and renovation work to ensure all asbestos items and materials are identified and scheduled for removal in an efficient and expedient manor.

1.2 SCOPE OF HAZARDOUS MATERIALS WORK

1.2.1 High Risk work procedures shall be required for the removal of asbestos containing materials within boilers and boiler exhaust breaching.

1.2.2 Moderate Risk work procedures shall be required for the removal of all other identified asbestos containing materials.

1.2.3 The contractor bidding on the work of this Section is directed to fully review all Phasing and *Prime Consultant*, Mechanical, Electrical and Structural Drawings relating to areas of renovation as outlined in the project specifications and drawings created for this project by the *Prime Consultant* to ensure all asbestos and lead containing applications in way of pending renovation work are removed in accordance with this Section.

1.2.4 Any work of removing finishes, fixtures or materials where such materials are directly attached to asbestos containing building finishes shall be performed and governed by the requirements outlined as Moderate Risk Asbestos Work in this Section.

1.2.5 The work of this section shall comply the *Risk Classifications* of High Risk for boiler packing and gasketing materials and boiler exhaust breaching removal. Removal work shall include, but not limited to full work area enclosure and worker decontamination shower for high risk work and work area isolation, HEPA filleted exterior exhausted negative pressure for all high risk work areas

1.2.6 All other asbestos and lead abatement work of this section shall comply the *Risk Classifications* of Moderate Risk. Removal work shall include, but not limited to work area isolation and worker decontamination and HEPA filleted exterior exhausted negative pressure in all areas where there is a potential for airborne dust creation.

1.2.7 Notification must be given to the Occupational Health and Safety province-wide Contact Centre at least 72 hours before workers may be exposed to airborne fibres. An Asbestos Project Notification form (Form WHS 3910) must be completed and submitted to Occupational Health and Safety.

1.2.8 All procedures listed in this Section are designed as a minimum standard that the *Contractor* must achieve. These procedures are intended to augment the *Contractor*'s site-specific work and safety procedures, not replace them.

1.2.9 The asbestos *Contractor* shall comply with all scheduling requirements and general conditions as outlined in the General Conditions, Contract Documents and Project Specifications for this renovation project.

1.2.10 All abatement work may be subject to monitoring and inspections by the *Hazardous Materials Consultant* empowered by the *Owner* to oversee the work of this Section.

1.2.11 The *Contractor* will be required to comply with all requirements enforced by the Alberta's Occupational Health and Safety Act, Regulation and Code (AARC) including but not limited to First Aid, Heat and Cold Stress and scaffolding and ladder requirements.

1.2.12 Due to the hazardous nature of the work for this project the *Hazardous Materials Consultant* empowered by the *Owner* shall have the authority to stop all or any work found to be in contraction to the project specification or the AARC until deficient items or actions are rectified as required. Work stoppage will be provided in the form of a Stop Work Order, outlining deficient items or items in contradiction to the above noted specifications or regulations. Work will not be allowed to continue until deficient items are rectified to the acceptance of the *Hazardous Materials Consultant*. The *Owner*, *Hazardous Materials Consultant* or *Prime Consultant* will accept no claims regarding delay costs or additions incurred costs due to the stoppage of work.

1.3 WORK INCLUDED

1.3.1 Moving, as required, all stored items and fixtures attached to or in way of asbestos applications scheduled for abatement.

1.3.2 Removal and disposal as asbestos waste, and all dust, debris and construction materials used to facilitate the work of this Section.

1.3.3 Removal and disposal of all drywall fastening and finishing devises including but not limited to nails, screws, corner bead etc.

1.3.4 Removal of any and all multiple layers of drywall found to contain asbestos drywall filler.

1.3.5 Maintaining water tightness in areas where exterior flashings, sealants and putties are to be removed to ensure there is no water ingress into the building.

1.4 SCHEDULE

1.4.1 All work is to comply with the phasing requirements listed in the General Contract Documents for this project.

1.5 HAZARDOUS WASTE HANDLING AND DISPOSAL

1.5.1 A waste generator number will be issued by the *Owner* and must appear on all waste transfer manifests.

1.5.2 All waste bins used for material transportation will be lockable, and will be locked at the end of each shift.

1.5.3 Waste bins are not to be filled higher than one foot from the top of the bin.

1.5.4 Fines, levies, dues, fees or penalties assessed for improper or illegal disposal of waste materials created through the execution of the work of this Section will be the sole responsibility of the *Contractor*.

2 DEFINITIONS

2.1 General

2.1.1 *Air Monitoring* - The process of measuring the fibre content of a known volume of air collected during a specific period of time. The procedure normally follows NIOSH 7400 analytical methodologies for fibres in air. For clearance *Air Monitoring*, electron microscopy methods may be utilized for lower detection limits and specific fibre identification.

2.1.2 *Authorized Visitor* - The Building *Owner* (and any designated representative) and any representative of a regulatory or other agency having jurisdiction over the project.

2.1.3 *Contractor* - The individual and/or business with which the Building *Owner* arranges to perform the asbestos abatement. It is recommended that wherever asbestos abatement is part of a larger project, the asbestos work be contracted separately and distinctly from other contract work. When this is not possible, the *Contractor* is responsible for the proper completion of the project activities in accordance with the contract specifications even where a sub-contractor has been retained to perform the actual abatement.

2.1.4 *Hazardous Materials Consultant* – Associated Environmental or his authorized agents or representative.

2.1.5 *Full Enclosure* – The technique of using duct tape and polyethylene sheeting to create and entire work area barrier seal capable of contained dust debris and water from escaping the *Work Area*. Such enclosure systems are synonymous with High Risk asbestos abatement enclosure systems for the removal of greater than one square foot (1ft^2) of friable asbestos.

2.1.6 *Glovebag* Technique - A method with limited applications for removing small amounts of friable asbestos-containing material from HVAC ducts, short piping runs, valves, joints, elbows and other non-planar surfaces in a non-contained (plasticized) work area. The *Glovebag* assembly is a manufactured or fabricated device consisting of a *Glovebag* (typically constructed of 6 mil transparent polyethylene or polyvinyl chloride plastic), two inward projecting long sleeves, an internal tool pouch, and an attached-labeled receptacle for asbestos waste. The *Glovebag* is constructed and installed in such a manner that it surrounds the object or material to be removed and contains all asbestos fibers released during the process. All workers who are permitted to use the *Glovebag* technique must be highly trained, experienced and skilled in this method.

2.1.7 *HEPA Filter* - A high efficiency particulate air filter capable of removing particles >0.3um in diameter with 99.97% efficiency.

2.1.8 *HEPA Vacuum* - A vacuum system equipped with HEPA filtration.

2.1.9 *Pressure* Ventilation System - A portable exhaust system equipped with HEPA filtration and capable of maintaining a constant low velocity airflow into contaminated areas from adjacent uncontaminated areas.

2.1.10 *Owner* – Parks Canada Agencyor their authorized representative.

2.1.11 *Partial Enclosure* – The technique of using duct tape and polyethylene sheeting to seal openings such as windows, doorways, stairways, elevators, HVAC duct openings and vents to create and air tight enclosure without the draping of walls and floors with polyethylene sheeting.

2.1.12 *Prime Consultant* – as defined in the project specifications and drawings prepared for this project.

2.1.13 *Prior Experience* - Experience required of the *Contractor* on hazardous material projects of similar nature and scope to insure capability of performing the asbestos abatement in a satisfactory manner. Similarities shall be in areas related to material composition, project size, abatement methods required, number of employees and the engineering, work practice and personal protection controls required.

2.1.14 *Risk Classification* – Moderate or High as required by these documents and as determined by the *Hazardous Materials Consultant*.

2.1.15 *Work Area Isolation* – The process of physically isolating a hazardous material work area from the surrounding building to ensure there is no movement of air, dust or debris from the work are to adjacent building areas.

2.1.16 *Work Area* - Designated rooms, spaces or areas of the project in which asbestos abatement actions are to be undertaken or which may become contaminated as a result of such abatement actions. A contained *Work Area* is a work area, which has been sealed, enclosed and equipped with a decontamination enclosure system. A non-contained *Work Area* is an isolated or controlled-access work area, which has not been enclosed, nor equipped with a decontamination enclosure system. *Work Area* shall herein refer to a single site or multiple of *Work Areas* within a single site.

2.1.17 *Worker Decontamination Enclosure* - A decontamination system consisting of a clean room, a shower room and an equipment room separated from each other and from the *Work Area* by airlocks and contained doorways.

3 WORKER PROTECTION

3.1 Risk Classification

3.1.1 High Risk shall be required for the removal of friable asbestos containing materials from within boilers and boiler exhaust breaching as required to facilitate renovation, demolition, structural, mechanical, plumbing and electrical work. *Full work area enclosure*, *worker decontamination enclosure*, PAPR Respirators and *Negative Pressure* Ventilation System will be required for all high risk work.

3.1.2 Moderate Risk shall be required for the removal of all other identified asbestos and lead paint applications and for the removal of any and all items in direct attachment to asbestos containing materials located within this facility where there exists a potential for asbestos disturbance or potential asbestos fibre release. Asbestos board is to be removed from areas as required to facilitate interior demolition, structural, mechanical, plumbing and electrical work for this project prepared by the *Prime Consultant.*

3.2 Respiratory Protection

3.2.1 The *Contractor* shall supply workers with personally issued, individually identified (marked with waterproof designations) respirators require for the work risk being performed. Half Face Air Purifying Respirators (APR) and Full faced, Power Air Purifying Respirators (PAPR) are required for abatement work included in this Section.

3.2.2 Respirators will only be issued to workers that are clean shaven.

3.3 Fit Testing

3.3.1 Workers shall be given a qualitative fit test in accordance with procedures detailed in the CSA fit testing protocol for all respirators to be used on this project.

3.3.2 Workers must perform positive and negative air pressure fit tests each time a respirator is put on, whenever the respirator design so permits.

3.3.3 Powered air-purifying respirators shall be tested for adequate flow as specified by the manufacturer, and the *Contractor* will retain a flow meter in designated area throughout removal.

3.4 Protective Clothing

3.4.1 Disposable clothing shall be Tyvek impermeable coveralls with head, foot coverings. Coveralls shall be used for full body protection and provided in sizes up to XXL. Sufficient quantities and adequate sizes shall be provided for all workers and *Authorized Visitor*s.

3.4.2 Hard hats, protective eye wear, gloves, steel-toed rubber boots and/or other footwear shall be provided as required for workers and *Authorized Visitor*s.

4 EQUIPMENT, TOOLS AND MATERIALS

4.1 General

4.1.1 Deliver all materials in the original packages, containers or bundles bearing the name of the manufacturer and the brand name (where applicable).

4.1.2 Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Replacement materials shall be stored outside of the *Work Area* until abatement is completed.

4.1.3 Damaged, deteriorating or previously used materials shall not be used and shall be removed from the work site and disposed of properly.

4.1.4 Warning sign materials as required by required by *Hazardous Materials Consultant*.

4.2 Equipment

4.2.1 A sufficient quantity of *Negative Pressure* ventilation units equipped with HEPA filtration and operated in accordance with ANSI 29.2-79 (local exhaust ventilation requirements) and EPA guidance document EPA 560/5-83-002 Guidance for Controlling Friable Asbestos Containing Materials in Buildings Appendix F: Recommended Specifications and Operating Procedures For the Use of *Negative Pressure* Systems for Asbestos Abatement shall be utilized so as to provide one work place air change every 15 minutes. All units are to be DOP tested prior to the start of abatement. If the units are located inside the abatement area and are direst exhaust to the outside of the building, a single DOP test will suffice. If the exhausts run through occupied areas the units must be DOP tested prior to the start of each removal phase.

4.2.2 Whenever possible, the units will be located at the furthest point from the decontamination facility.

4.2.3 To calculate total air flow requirement:
Total ft3/min = Vol. of *Work Area* (in ft3)

4.2.4 To calculate the number of units needed for the abatement:
Number of units needed = total cu. ft/min
Capacity of unit in cu. ft/min

4.2.5 A sufficient supply of scaffolds, ladders, lifts and hand tools (e.g.. scrapers, wire cutters, brushes, utility knives, wire saws, etc.) shall be provided as needed.

4.2.6 Sprayers with pumps capable of providing no more 500 pounds per square inch (psi) at the nozzle tip at a flow rate of 2 gallons per minute for spraying amended water are acceptable.

4.2.7 Rubber dustpans and rubber squeegees shall be provided for cleanup.

4.2.8 Brushes utilized for removing loose asbestos containing material shall have nylon or fiber bristles, not metal.

4.2.9 A sufficient supply of *HEPA Filtere*d vacuum systems shall be available during cleanup.

4.2.10 Encapsulants shall be sprayed using airless spray equipment. Nozzle pressure should be adjustable within the 400 to 1500 psi range depending on the encapsulant's viscosity and solids content. Tip size shall also be based on manufacturer's recommendations.

4.2.11 Consideration shall be given to any recommendations from the manufacturer regarding respiratory protection requirements for the encapsulating product.

4.2.12 The use of air supplied respirators for the spraying of encapsulants will negate this requirement, however care must then be taken regarding the respirable air supply to the system in accordance with CSA grade D requirements.

4.3 Enclosure Materials

4.3.1 Enclosure materials shall be normal construction grade, and conform with the following characteristics.

- Rigid construction
- Framing on 12", 16" or 24" spacing as appropriate
- Plywood sheathed where specified
- Doorways to be reinforced.

4.3.2 The enclosures shall be constructed of materials such that when the enclosure is completed there is limited potential for impact damage to the enclosure and no potential for fibre release.

4.3.3 Other (specify, where fire, thermal or sound performance related assemblies are required for enclosure projects. The applicable ASTM and/or CSA material, installation, application, specification, specifications or recommended practice should be utilized.

4.3.4 Additional materials as necessary for removal, as specified.

4.4 Abatement Materials

4.4.1 Amended water - Water to which a chemical wetting agent has been added to improve penetration.

4.4.2 Disposal bags shall be of 6-mil polyethylene, pre-printed with labels as required by EPA regulation OSHA requirement 29 CFR 1910,1001 (g) (2) (ii).

4.4.3 Disposal drums shall be metal or fibreboard with locking tops.

4.4.4 Polyethylene sheeting for walls and stationary objects shall be a minimum of 6 mil thickness. For floor uses and bin linings, woven sheeting of at least 10 mil thickness shall be used in widths selected to minimize the frequency of joints.

4.4.5 Method of attaching polyethylene sheeting shall be agreed upon in advance by the *Contractor* and the *Hazardous Materials Consultant* and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of duct tape or other waterproof tape, furring strips, spray glue, staples, nail, screws or friction fit walls of sealing adjacent sheets of polyethylene and capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions (including the use of amended water).

4.4.6 Polyethylene sheeting utilized for *Worker Decontamination Enclosure* shall be orange in colour.

4.4.7 Special materials required to protect objects in the *Work Area* such as carpeting or hardwood floors to prevent damage from scaffolds and falling material should be of good construction grade.

4.5 Encapsulation materials

4.5.1 Encapsulation materials shall be bridging type and conform with the following characteristics:

- Encapsulants should not be solvent based or utilize a vehicle (the liquid in which the solid parts of the encapsulant are suspended) consisting of hydrocarbons.
- Encapsulants shall not be flammable

4.5.2 Additional materials as necessary for removal, as required.

5 MONITORING

5.1 Air Monitoring

5.1.1 The following Air Monitoring work will be performed by the Owner or their authorized representative at their discretion.

5.1.2 *Air Monitoring* shall be performed by the *Hazardous Materials Consultant* in accordance with NIOSH 7400 A Counting Rules methodologies. Samples will be collected at times and locations as determined by the *Hazardous Materials Consultant.*

5.1.3 The *Contractor* shall assist the *Hazardous Materials Consultant* in the collection of air samples, including the provision of workers to war sampling pumps for up to a full work shift period and the provision of adequate, uninterrupted power for low amperage vacuum/pressure type air sampling pumps.

5.1.4 Airborne fiber levels within abatement work areas found in excess of fifty percent (50%) of the Maximum Threshold Limit Value for the work being performed (i.e. 0.5 fibbers/cc for Moderate and Modified Moderate and 5.0 fibbers/cc for High Risk Work) will require the increase in *Risk Classification* to the next highest level or respiratory protection of a greater safety factor. Any costs associated within this change in abatement *Risk Classification* will be borne solely by the *Contractor*. It is the *Contractors*' responsibility to ensure and maintain airborne fibre levels within abatement work areas to a level below fifty percent (50%) of the Maximum Threshold Limit Value for the work being performed.

5.1.5 Airborne fiber levels found in excess of 0.02 fibres/cc adjacent to the work area, within the clean room or holding room shall indicate asbestos contamination of these areas. Such areas shall be isolated and cleaned in a manner similar to the *Work Area* at no additional cost to the *Owner*. Such areas shall be considered to be contaminated until acceptable airborne fiber levels of 0.02 fibers/cc and below are established in the area.

5.1.6 *Air Monitoring* within the *Work Area* to establish acceptable clearance and tear-down conditions shall be conducted following a visual inspection approval of *Work Area* clean-up procedures and the application of a slow drying sealer to all surfaces within the work area. Airborne fibre levels must be 0.02 fibers/cc and below to be considered acceptable. Airborne fibre levels in excess of 0.02 fibre/cc shall require repeated clean-up and an additional coat of sealant until acceptable airborne fibre levels are established.

5.2 Inspections

5.2.1 The following Inspection work may be performed by the Owner or their authorized representative.

5.2.2 The Hazardous Materials Consultant is empowered by the *Owner* to periodically inspect site conditions and work procedures inside and outside the work area.

5.2.3 The *Hazardous Materials Consultant* is empowered by the *Owner* to order the *Contractor* to stop work at any time the conditions of the specifications have not been complied with or if there are violations to the AARC IH&S Regulations.

5.2.4 The *Owner* or his representative will not be held responsible for any work stoppages, delays or any other disruptions occurring due to the conditions of the specifications not being complied with.

5.2.5 Inspection services performed as a result of the *Contractor*'s failure to conform to specified procedures, as determined by the *Hazardous Materials Consultant* at the time of a Milestone Inspection, may be charged to the *Contractor* and may be deducted from money's owing to the *Contractor*.

5.2.6 The *Hazardous Materials Consultant*, at his discretion, shall undertake the following milestone inspections which shall be included as critical events in the construction schedule:

5.2.6.1 **Milestone Inspection A** - Pre-contamination: inspection of *Work Area* preparation and set-up prior to disturbance of asbestos-containing or asbestos-contaminated materials.

5.2.6.2 **Milestone Inspection B** - Pre-removal: inspection of *Work Area* and set-up prior to removal of asbestos containing materials.

5.2.6.3 **Milestone Inspection C** - Visual clearance: inspection of *Work Area* following clean-up work procedures but prior to final teardown procedures.

5.2.6.4 **Milestone Inspection D** - Air clearance: inspection and *Air Monitoring* of *Work Area* following Milestone Inspection C and the application of a slow drying sealer in the *Work Area* but prior to final tear-down procedures.

5.2.6.5 **Milestone Inspection E** - Enclosure Tear-down: inspection following final teardown procedures.

6 MODERATE RISK WORK

6.1 Preparation of Work Areas

6.1.1 Isolate the Work Area from adjacent building using polyethylene sheeting covering openings and penetrations from the work area to the surrounding building as required.

6.1.2 Cover floor surfaces in the immediate work area for the removal of asbestos applications. Drop sheets shall be suitably sized to catch and collected any materials, which may be, release during waste handling.

6.1.3 Coordinate the Isolation of the HVAC air supply and return from the immediate Work Area if required. If isolation is not practical, cover all supply diffusers and return air grates with polyethylene, tapes sealed along all free edges to prevent airflow if required.

6.1.4 Coordinate the Isolation of electrical systems within the immediate Work Area. Isolation shall include, but is not limited to lighting, power outlets, intrusion alarms, smoke and fire detection equipment. If isolation is not practical, all live electrical systems within the Work Area shall be identified as LIVE in large florescent letters as required for easy visual identification.

6.1.5 Establish a staging area at an entrance to the work area. The staging area shall be sized to allow temporary storage of double bagged asbestos waste materials and shall be used for personnel decontamination upon leaving the work area.

6.2 Asbestos Removal Work Procedures

6.2.1 Prior to the start of any work involving asbestos, any persons working in the immediate area should be informed of the nature of the work and that suitable precautions will be used to ensure that they are not exposed to asbestos fibres.

6.2.2 Prior to the start of any asbestos disturbance work, co-ordinate the isolation of the heating, cooling, and ventilation air systems within occupied areas services by the same system as the Moderate Risk Work area. Isolate or tape and seal, with duct tape and 6mil polyethylene, all supply diffusers within un-occupied areas services by the same system as the Moderate Risk Work area. (If taping and sealing of supply diffusers proves to be inadequate, rigid metal caps screwed to diffusers will be required)

6.2.3 Prior to the start of any asbestos disturbance work, co-ordinate the isolation of all building electrical systems that may be affected through the scheduled Moderate Risk Work.

6.2.4 Where practical, move all furnishings or equipment in the immediate work area. Any furnishings or equipment not removed shall be adequately covered and sealed using 6 mil polyethylene and tape.

6.2.5 Post signs or barrier tape to indicate asbestos hazard and the requirement for protective clothing for anyone entering the work area.

6.2.6 Post NOPA, Fit Test documentation, MSDS sheets, and work procedures outside of the work area.

6.2.7 Wear all required protective equipment. Equipment shall include, but is not limited to, dual cartridge Air Purifying Respirators (APR), disposable coveralls, gloves, eye and head protection as required. Ensure that the coveralls integral head and foot coverings of disposable coveralls are used.

6.2.8 *To remove asbestos floor tile (without asbestos paper backing):* Ensure all lower wall surfaces are covered with a polyethylene film to minimize the spread of debris materials. Where required, or as directed by the Hazardous Materials Consultant, remove floor mounted objects that interfere or cover asbestos flooring applications. Utilizing appropriate tools, remove vinyl flooring in manageable sections. Bag debris materials as the work progresses; DO NOT allow asbestos waste to accumulate on floor. Pick-up and HEPA Vacuum surrounding area and sub-flooring until all visible debris material is removed.

6.2.9 *To remove pipe flange gasketing materials*: Pre-clean surfaces surrounding the immediate removal location by HEPA vacuuming or wet cleaning methods. Ensure polyethylene drop sheets are placed beneath the material to be removed to catch all debris created through the abatement activities. Saturate the asbestos material to be removed with amended water. Unbolt pipe section and separate to expose gasketing materials. Once the flanges have been separated, saturated the gasketing materials again and remove the gasket from the metal flanges using appropriate scrapers and hand tools. Place waste materials directly into labeled bags for disposal as asbestos waste. Using wet scrub pads, scrub any remaining residual material from substrate and wash. Collect wash water in a bag for disposal. Dry substrate with a cloth and re-inspect for any residual material. If residual debris is found, re-scrub and wash until all debris has been removed.

6.2.10 *To remove asbestos duct joint sealant materials:* Tape seal visible duct joint mastic with two (2) wraps of duct tape and cut ductwork on either side of tape sealed sealant. Remove the enclosed asbestos containing high velocity duct joint sealant sections for disposal as asbestos contaminated waste.

6.2.11 *To remove asbestos ceiling tile glue (mastic) applications:* Pre-clean surfaces surrounding the immediate removal location by HEPA vacuuming or wet cleaning methods. Ensure polyethylene drop sheets are placed beneath the glue patches to be removed to catch all debris created through the materials abatement. Saturate the asbestos mastic with amended water. Once saturated, carefully pry mastic from the ceiling substrate utilizing appropriate tools. Place waste materials directly into labeled bags for disposal as asbestos waste. Using wet scrub pads, scrub any remaining residual material from substrate and wash. Collect wash water in a bag for disposal. Dry substrate with a cloth and re-inspect for any residual material. If residual debris is found, re-scrub and wash until all debris has been removed.

6.2.12 *To remove drywall tape compound and contaminated gypsum materials:* Pre-clean surfaces surrounding the immediate removal location by HEPA vacuuming or wet cleaning methods. Ensure polyethylene drop sheets are placed beneath the material to be removed to catch all debris created through the materials abatement. Saturate the asbestos material with amended water. Once saturated, carefully remove mounting items, including nails, corner beads, tack strips or tracks utilizing appropriate tools to free the material from attachment to the substrate. Use care to minimize damage to substrate materials. Place waste materials directly into labeled bags for disposal as asbestos waste. Using wet scrub pads, scrub any remaining residual drywall materials from substrate and wash; collected wash water in a bag for disposal. Dry substrate with a cloth and re-inspect for any residual material. If residual debris is found, re-scrub and wash until all debris has been removed.

1.1.1 *To remove cast iron bell and spigot union packing materials:* Ensure poly drop sheets are placed in the immediate area surrounding the pipe union to be removed. Tape seal union with a minimum of two (2) full overlapping wraps of duct or other heavy cloth tape. Utilizing a chain break, cut-off saw or other suitable means cut the cast iron pipe on either side of the pipe union and extract union and place on the ground. Inspect the union and tape seal for beaches – if no breach in the tape seal is evident, containerize union for disposal as asbestos waste – if a breach is observed, inspect surrounding work area for visible signs of dust or suspect asbestos debris and clean as appropriate and containerize union for disposal as asbestos waste. Collect poly drop sheets and bag for disposal as asbestos waste.

1.1.2 *To remove pipe insulation and insulating cement materials***:** Utilize an approved glove bag in accordance with the manufacturer's specifications. Wet insulation and carefully cut jacket and keep surface of insulation wetted by mist of water with wetting agent. Remove insulation in large sections and place immediately into bottom of glove bag. After all large pieces have been removed, saturate adhering material and pipe and wet clean using abrasive pads, sponges, cloths, etc. Wash pipe and interior of glove bag to remove all visible debris to the lower portion of the bag. Inspect for any visible residual insulation debris in upper portion of bag and on cleaned piping. Once all visible debris has been removed, apply an application of a fast drying bridging encapsulant as required to lock down any residual fibres. Gooseneck asbestos waste in lower portion of the glove bag and seal closed with tape. Prior to removing the glove bag from the piping, remove all air from within the glove bag with a HEPA equipped vacuum. Cut and remove glove bag from pipe and place directly into labeled 6-mil waste bags for disposal.

6.2.13 *To remove asbestos window putty, flashing or sealant materials:* Ensure all loose and putty materials are pre-cleaned by HEPA vacuuming. Ensure poly drop sheets are placed on both sides of the material to be removed to catch and contain any debris released through the removal of putty/sealant materials. Remove window stops or flashing and containerize for disposal as asbestos waste. Remove window glass and clean putty from window surfaces. Inspect and clean all substrate surfaces of asbestos window putty or sealant materials. Containerize all contaminated materials for disposal as asbestos waste.

6.2.14 *To cut or remove lead containing paint applications:* Ensure all loose paint materials are pre-cleaned by HEPA vacuuming. Ensure poly drop sheets are placed to catch and contain any debris released through the removal or cutting of leaded paint materials. Utilizing dustless technology, cut paint and substrate materials in areas where removal is required to facilitate renovation work. In areas where lead paint removal is required, utilize appropriate and *Owner* accepted paint stripping materials to remove lead paint applications from the building substrate in accordance with written manufactures instructions. Containerize removed materials for disposal as lead contaminated waste – TCLP Leachate Testing of removed materials as required to determine disposal criteria is the responsibility of the *Contractor.*

6.2.15 Remove window stops or flashing and containerize for disposal as asbestos waste. Remove window glass and clean putty from window surfaces. Inspect and clean all substrate surfaces of asbestos window putty or sealant materials. Containerize all contaminated materials for disposal as asbestos waste.

6.3 Personnel Entry and Exit

6.3.1 At completion of work, all equipment, tools and materials used in the *Work Area* should be decontaminated by wet cleaning or *HEPA Vacuum*.

6.3.2 Drop sheets and enclosures that are to be reused shall be cleaned by using a *HEPA Vacuum* or by damp wiping. Drop sheets and enclosures that are to be disposed of shall be wetted, folded and placed in 6 mil polyethylene bags for disposal.

6.3.3 Before leaving work area, a worker shall decontaminate his shoes and protective clothing by using *HEPA Vacuum* or damp wiping. When protective clothing is to be disposed of, it shall be decontaminated as above and placed in labeled disposal bags. Workers shall vacuum all exposed skin, suit, respirator and hair (after removing hood) and proceed to nearest washroom to wash hands and face, or use bucket filled with warm soapy water and sponge off all exposed skin areas.

6.3.4 After drying off, inspect and clean respirator of any residual asbestos debris before storage.

7 HIGH RISK WORK PROCEDURES

7.1 Preparation of *Work Areas*

7.1.1 Moderate risk personnel protection procedures shall apply during *Work Area* preparation where the risk of dislodging asbestos fibres or disturbing asbestos-containing applications exists.

7.1.2 Coordinate work by others, the Isolation of the HVAC air supply and return from the immediate *Work Area* if required. If isolation is not practical, cover all supply diffusers and return air grates with polyethylene, tapes sealed along all free edges to prevent airflow if required.

7.1.3 Coordinate work by others, the Isolation of electrical systems within the immediate *Work Area.* Isolation shall include, but is not limited to lighting, power outlets, intrusion alarms, smoke and fire detection equipment. If isolation is not practical, all live electrical systems within the *Work Area* shall be identified as **LIVE** in large florescent letters as required for easy visual identification.

7.1.4 Remove all floor and wall-mounted objects, which interfere with asbestos abatement as required by the *Hazardous Materials Consultant*. Label such items for re-attachment and store in areas designated by the *Owner* or others and protect from damage and re-contamination.

7.1.5 Remove window(s), using qualified trades, to allow access to the *Work Area* or to allow exhaust of air movement equipment. Install plywood panels to maintain building security.

7.1.6 Detach and support for replacement, as appropriate, wall, floor and ceiling mounted objects including mechanical pipe hangers, electrical systems, water basin cabinets, panel boxes, junction boxes, conduit, cable trays and cable raceways, water lines, sprinkler lines gas lines and other mounted objects as required and protect from re-contamination.

7.1.7 Establish critical barriers at all points of entry to the work area. Construct such barriers of friction fit 38 mm x 89 mm timber framing, covered on both sides by opaque, woven plastic sheeting. Abut barrier framework to existing building structures including beams, walls, columns and door frames. Stuff all openings between the wood and the building structure with glass fibre material and seal along all free edges with tape. Cover all points of entry, not intended for use during the work of this section, with an additional layer of plywood sheeting.

7.1.8 Ensure that all holes or openings in existing wall, ceiling and floor structures are adequately sealed.

7.1.9 Crate over and protect from damage all fixed objects in the removal area.

7.1.10 Cover and seal floor surfaces from contamination with 10mil rip stop polyethylene sheeting.

7.1.11 Isolate the *Work Area* from adjacent building using *Full Enclosure* as required.

7.2 Worker Decontamination Enclosures

7.2.1 Worker Decontamination Enclosures shall be constructed in locations approved by the *Owner* or *Hazardous Materials Consultant*. A *Worker Decontamination Enclosure* System shall be constructed and installed as follows:

7.2.1.1 <u>Equipment and access room:</u> build equipment and access room between shower room and contiguous with the work area, with two curtain doorways, one to shower room and to work area. Install waste receptor, and storage facilities for workers' shoes and any protective clothing to be worn again in work areas.

7.2.1.2 <u>Shower room</u>: build shower room between clean room and equipment and access room, with two curtain doorways, one to clean room and one to equipment and access room. Shower rooms shall be walk through type, ensure entry and exit through actual showers by opposing doors, such that access to clean room from shower room must be through actual showers. Contractor shall provide hot and cold water supply in each Work Area and must provide a minimum of two shower heads, self activating pump for disposal of waste water and leak proof connections to water supply. Provide qualified trades personnel to install and disassemble water supply connections. Locate taps to control water temperature and supply within individual showers. Provide additional shut-off taps in the clean room area for shower and Work Area water supply. Provide adequate soap and shampoo for persons required to use this facility. Provide proper containers for disposal of used filters and maintain same.

7.2.1.3 Provide piping and connect to water sources and drains. Pump waste water through 5 micrometre filter system acceptable to the Owner before directing into drains. Shower room to be maintained in clean condition.

7.2.1.4 Clean room: build clean room between shower room and clean areas outside of enclosures, with one curtain doorway leading to shower room and second lockable door to outside of enclosures. Provide lockers or hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly. Provide bench for workers to sit on when changing clothes. Clean room shall provide adequate space for four workers to dress comfortably. Clean room to be maintained in clean and orderly condition at all times. Provide one clean towel per worker per decontamination for all workers on site.

7.3 Construction of Decontamination Enclosures

7.3.1 Locate decontamination enclosure at the area of largest floor sheeting removal and as directed by the *Hazardous Materials Consultant*.

7.3.2 Build suitable framing for enclosures; Decontamination systems to be made from 38 mm x 89 mm timber framing at 600 mm centres with plywood sheathing on walls and roof, lined with 0.15 mm polyethylene on walls and a double layer of 0.25 mm polyethylene on the floor. Construction shall be of quality and design to assure against leakage of asbestos fibres and/or water to areas outside scope of work.

7.3.3 Build curtain doorways designed so when workers or drums and equipment move through doorway, one of two barriers comprising doorways always remains closed.

7.3.4 Provide lockable doors at entrances to clean room and holding room of the decontamination enclosure systems.

7.3.5 Locate switch for temporary lighting inside the clean room.

7.3.6 Locate *Work Area* water supply shutoff inside the clean room.

7.4 Maintenance of Enclosures

7.4.1 Enclosures shall be maintained in clean and tidy condition.

7.4.2 Ensure barriers and plastic linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

7.4.3 Visually inspect enclosures regularly and at the beginning of each working period.

7.4.4 Maintain emergency and fire exits from the work areas, or establish alternative exits satisfactory to fire officials.

7.4.5 Establish and maintain a *Negative Pressure* within the *Work Area* as specified by this section. One (1) air change every 15 minutes shall be required. Ensure *Negative Pressure* requirements are maintained relative to pressures maintained in existing mechanical systems. Exhaust ducting from all air movement equipment installed in the *Work Area* shall extend outside of the building to areas meeting the approval of the *Hazardous Materials Consultant*. Air movement equipment shall operate continuously from the time of initial asbestos disturbance until approval of clean-up procedures by the *Hazardous Materials Consultant* or as directed by the *Hazardous Materials Consultant*.

7.4.6 Work at risk of dislodging asbestos SHALL NOT commence until:

7.4.6.1 Signs are placed in areas where access to the sealed asbestos removal area is possible. Such signs shall be located inside first curtain doorway and shall read:

7.4.6.2 Evidence is provided of notification to the Provincial AARC.

7.4.6.3 Air movement equipment is operating as specified.

7.4.6.4 The *Hazardous Materials Consultant* has been notified of intention to proceed and has inspected and approved in writing enclosures, equipment and procedures ('Milestone Inspection A' PRE-CONTAMINATION INSPECTION).

7.4.6.5 All workers and personnel having cause to enter the *Work Area* are appropriately protected, as specified.

7.5 Personnel Entry and Exit

7.5.1 All workers and authorized personnel shall enter the *Work Area* through the *Worker Decontamination Enclosure* system.

7.5.2 All personnel who enter the *Work Area* must be listed in the entry log, located in the clean room.

7.5.3 All personnel who enter the *Work Area* shall read and be familiar with all posted regulation, personal protective requirements (including work place entry and exit procedures) and emergency procedures. A sign-off sheet shall be used to acknowledge that these have been received and understood by all personnel prior to entry.

7.5.4 All personnel shall proceed first to the clean room, removal all street clothes and appropriately don the assigned respiratory protection deemed suitable for the project conditions and launder able (if appropriate) and/or disposable coveralls, head covering and foot covering. Hard hats, eye protection and gloves shall also be utilized if required. Clean respirators and protective clothing shall be provided and utilized by each person for each separate entry in to the work area.

7.5.5 Workers must perform positive and negative air pressure fit tests each time a respirator is put on, whenever the respirator design so permits

7.5.6 Personnel wearing designated personal protective equipment shall proceed from the clean room through the shower room and equipment room to the main work area.

7.5.7 Before leaving the *Work Area* all personnel shall remove gross contamination from the outside of respirators and protective clothing by brushing vacuuming, and/or wet wiping procedures. Each person shall clean bottoms of protective footwear in the walk-off pan just prior to entering the equipment room.

7.5.8 Personnel shall proceed to the equipment room where they remove all protective equipment except respirators. Deposit disposable (and launder able) clothing into appropriately labeled containers for disposal (and laundering).

7.5.9 Reusable, contaminated footwear shall be stored in the equipment room when not in use in the work area. Boot storage pegs will be provided to allow for draining and drying. Upon completion of abatement rubber boots may be decontaminated for reuse.

7.5.10 Still wearing respirators, personnel shall proceed to the shower area, clean the outside of the respirators and the exposed face area under running water prior to removal of respirator and shower and shampoo to remove residual asbestos contamination. Various types of respirators will require slight modification of these procedures.

7.5.11 After showering proceed to the mask storage room.

7.5.12 After drying off, inspect and clean respirators of any residual asbestos debris before storage then proceed to the clean room and don street clothes.

7.5.13 These procedures, or the General *Contractor*'s equivalent, shall be posted in the clean room and equipment room.

7.6 Work Procedures

7.6.1 No asbestos disturbance or removal work shall be undertaken without a work area inspection and written approval by the *Hazardous Materials Consultant* if applicable

7.6.2 Clean and isolate the *Work Area* in accordance with the requirements of the specification.

7.6.3 Wet all asbestos containing material with amended water solution using equipment capable of providing a fine spray mist, in order to reduce airborne fiber concentrations when the material is disturbed. Saturate the material to the substrate, however, do not allow excessive water to accumulate in the work area. Keep all removed material wet enough to prevent fiber release until it can be containerized for disposal. If *Work Area* temperatures are below $0^{o}C$ and amended water is subject to freezing, dry removal permits and procedures may be utilized after discussion with the *Hazardous Materials Consultant*. Wetting procedures are not equally effective on all types of asbestos containing materials but, shall none-the-less be used in all cases.

7.6.4 Saturated asbestos containing material shall be removed in manageable sections, removal material should be contained in bags, or containers before moving to a new location for continuance of work. Surrounding areas shall be periodically sprayed and maintained in a wet condition until visible material is cleaned up.

7.6.5 Material removed from building structures or components shall not be dropped or thrown to the floor to avoid damage to the poly, and to reduce fibre release. Material should be removed as intact sections or components whenever possible and carefully lowered to the floor. If this cannot be done for materials greater than 50 feet above the floor, a dust-tight chute shall be constructed to transport the material to containers on the floor or the material may be containerized at elevated levels (e.g. on scaffolds) and carefully lowered to the ground by mechanical means. For materials between 15 and 50 feet above the ground they may be containerized at elevated levels or dropped onto inclined chutes or scaffolding for subsequent collection and containerization. Equipment removed form structures must be lowered to the ground.

7.6.6 *To remove asbestos insulation on boiler exhaust breaching and within boilers:* Ensure all openings in walls and floors are covered with polyethylene sheeting. Line floor areas to catch any debris created through the removal of the insulation. Remove all covering or enclosing materials, wet wash clean and remove from the work area and protect from contamination. Wet asbestos applications to be removed with a solution of amended water. Utilize appropriate tools to remove the insulation in manageable sections. Bag debris materials as the work progresses, DO NOT allow asbestos waste to accumulate on floor. Remove all fastening and finishing materials including but not limited to nails, screws, corner beads and dispose of as asbestos waste. Using wet scrub pads, scrub any remaining residual material from substrate and wash. Collect wash water in a bag for disposal. Dry substrate with a cloth and re-inspect for any residual material. If residual debris is found, re-scrub and wash until all debris has been removed. Pick-up and HEPA vacuum surrounding area until all visible debris material is removed.

7.6.7 Containers (6-mil polyethylene bags or drums) shall be sealed when full. (Wet material can be exceedingly heavy. Double bagging of all waste material is necessary, unless the material is being placed into containers. Bags shall not be overfilled. They should be securely sealed to prevent accidental opening and leakage by tying tops of bags in an overhand knot or by taping in gooseneck fashion. Do not seal bags with wire or cord. (Bags may be placed in drums for staging and transportation to the landfill.

7.6.8 Large components removed intact may be wrapped in 2 layers of 6-mil polyethylene sheeting secured with tape for transport to the landfill.

7.6.9 Asbestos containing waste with sharp-edged components (e.g. nails, screws, metal and wooden lath, tin sheeting) will tear the polyethylene bags and sheeting and shall be placed into drums for disposal.

7.6.10 The *Contractor* will remove waste containers on a regular basis. In the case of two shifts, the last two hours of the second shift will be used for waste removal.

7.6.11 After completion of all abatement work, surfaces from which asbestos containing materials have been removed shall be *HEPA Vacuumed,* wet brushed and sponged or cleaned by some equivalent method to remove all visible residue.

7.6.12 Clean-up shall proceed in accordance with the specifications. Wet clean all mechanical, electrical and building structure surfaces within the work area. Change rinse water often to prevent the spreading of contamination around with contaminated water and to prevent leaving a residue once the wash water has dried.

7.6.13 After the *Work Area* has been rendered free of visible residues, a thin coat of a specified encapsulating agent shall be applied to all surfaces in the *Work Area* including structural members, building components and plastic sheeting on walls, floors and covering non-removable items, to seal in non-visible residue. (Note: 1) High temperature components such as boilers and pipes may not permit the application of some encapsulants. 2) If fireproofing insulation or acoustical materials are to be reapplied to the abated area, be certain that the encapsulant selected will permit good adhesion to the substrate. A small area should be tested before application, or the General *Contractor* will provide a letter of performance stating that the application of the product over the encapsulant will not affect the warranty.

7.6.14 Special circumstances (e.g. live electrical equipment, high Amosite content of material, materials previously coated with an encapsulant or paint) may prohibit the adequate use of wet methods to reduce fiber concentrations. For these situations, a dry removal may be required. The General *Contractor* may have to apply to the AARC for a variance for dry removal.

7.6.15 *Air Monitoring* may be conducted by the *Hazardous Materials Consultant* in accordance with regulatory requirements, and the requirements of the *Hazardous Materials Consultant*'s *Air Monitoring* strategy.

7.6.16 Airborne fiber levels will not exceed Levels adopted by AARC.

8 FINAL CLEAN-UP

8.1 General

8.1.1 *HEPA Vacuum* and wet clean all surfaces in the work area. Use rags, mops and sponges as appropriate to remove all visible dust and debris materials. (Note: Some *HEPA Vacuum*s might not be wet-dry vacuums. To pick up excess water and gross wet debris, a HEPA equipped wet-dry vacuum must be used.)

8.1.2 The *Work Area* enclosure shall be cleaned until ALL visible asbestos containing debris is removed and the enclosure is in compliance with regulatory requirements for clearance.

8.1.3 Upon the completion of final cleaning activities and successful completion of 'Milestone Inspection C - VISUAL CLEARANCE", if performed, apply a layer of bridging encapsulant to all surfaces within the work area. Allow the glue application to set prior to dismantling of the *Work Area* enclosure.

9 EQUIPMENT DECONTAMINATION

9.1 General

9.1.1 At the completion of work, all equipment, tools and materials used in the *Work Area* should be decontaminated by wet cleaning or *HEPA Vacuum* prior to their removal from the work area.

10 CLEARANCE AIR MONITORING AND INSPECTIONS

10.1 General

10.1.1 The following Clearance Air Monitoring and Inspection work may be performed by the Owner or their authorized representative.

10.1.2 Following the completion of clean-up operations, the *Hazardous Materials Consultant* will, at his discretion, conduct air clearance monitoring of the *Work Area* in accordance with regulatory requirements, while at the same time inspecting the area for additional debris which may have been dislodged during the application of the sealer.

10.1.3 Work areas found to be in excess of clearance criteria established by the Workers' Compensation Board shall be re-cleaned and a second coat of a lock down sealer will be applied to all surfaces within the work area.

10.1.4 Following the satisfactory completion of clearance *Air Monitoring*, the *Contractor* will be directed to proceed with *Work Area* tear down activities.

11 WASTE DISPOSAL PROCEDURES

11.1 Requirements

11.1.1 Disposal of all asbestos waste will be conducted in accordance with the Ministry of Environment regulations pertaining to hazardous waste.

11.1.2 A waste generator number will be issued by the *Owner* and provided to the *Contractor* by the *Hazardous Materials Consultant*. This waste generator number will appear on all waste transfer manifests.

11.1.3 Disposal must occur at an authorized site in accordance with regulatory requirements.

11.1.4 Copies of all dump receipts, trip tickets, transportation manifests or other documentation of disposal shall be delivered to the Building *Owner* for his records. A recommended record keeping format utilizes a chain of custody form, which includes the names and addresses of the Generator (Building *Owner*), *Contractor*, pickup site, and disposal site, the estimated quantity of the asbestos waste and the type of containers used. The form should be signed by the *Hazardous Materials Consultant*, the *Contractor*, and the Disposal Site Operator, as the responsibility for the material changes hands. If a separate waste hailer is employed, his name, address, telephone number and signature should also appear on the form.

11.1.5 Any asbestos materials stored on site will be stored in a sealed locked container.

11.1.6 Containers will not be filled to capacity for transport.

11.1.7 Any costs associated with any asbestos materials generated from the abatement once the materials leave the *Owner*s premises is the sole responsibility of the asbestos *Contractor*.

11.1.8 If the asbestos *Contractor* elects to transport the waste in his own truck, he will provide a secure storage area until sufficient material has been assembled for transport.

11.2 Transportation to the Landfill

11.2.1 Once drums, bags and wrapped components have been removed from the work area, they shall be loaded into a container or an enclosed truck for transportation. If the asbestos *Contractor* is utilizing his own vehicles for transportation he shall provide proof of his registration as a hazardous waste transporter.

11.2.2 When moving containers, utilize hand trucks, carts and proper lifting techniques to avoid back injuries. Trucks with lift gates are helpful for raising drums during truck loading.

11.2.3 The enclosed cargo area of the truck shall be free of debris and lined with 6 mil polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting shall be installed first and extend up the side walls. Wall sheeting shall be overlapped and taped into place.

11.2.4 Drums shall be placed on level surfaces in the cargo area and packed tightly together to prevent shifting and tipping. Large structural components shall be secured to prevent shifting and bags placed on top. Do not throw any containers into truck cargo area.

11.2.5 Personnel loading asbestos containing waste shall be protected by disposable clothing including head, body and foot protection and at a minimum, half-facepiece, air purifying, dual cartridge respirators equipped with high efficiency filters.

11.2.6 Any debris or residue observed on containers or surfaces outside of the *Work Area* resulting from clean-up or disposal activities shall be immediately cleaned-up using *HEPA Filtere*d vacuum equipment and/or wet methods as appropriate.

11.2.7 Large metal containers are sometimes used for asbestos waste disposal. These should have doors or tops that can be closed and locked to prevent vandalism or other disturbance of the bagged asbestos debris and wind dispersion of asbestos fibres. Un-bagged materials shall not be placed in these containers, nor shall it be used for non-asbestos waste. Bags shall be placed, not thrown, into these containers to avoid splitting.

11.3 Disposal at the Landfill

11.3.1 Upon reaching the landfill, trucks are to approach the dump location as closely as possible for unloading of the asbestos containing waste.

11.3.2 Bags, drums and components shall be inspected as they are off-loaded at the disposal site. Material in damaged containers shall be re-packed in empty drums or bags as necessary. (Local requirements may not allow the disposal of asbestos waste in drums. Check with appropriate agency and institute appropriate alternative procedures.)

11.3.3 Waste containers shall be placed on the ground at the disposal site, not pushed or thrown out of trucks (weight of wet materials could rupture containers).

11.3.4 Personnel off-loading containers at the disposal site shall wear protective equipment consisting of disposable head, body and foot protection and, at a minimum, half-facepiece, air-purifying, dual cartridge respirators equipped with high efficiency filters.

11.3.5 Following the removal of all containerized waste, the truck cargo area shall be decontaminated using *HEPA Vacuum*s and/or wet methods to meet the no visible residue criteria. Polyethylene sheeting shall be removed and discarded along with contaminated cleaning materials and protective clothing, in bags or drums at the disposal site.

11.3.6 If the landfill operator has not provided landfill personnel with personal protective equipment for the compacting operation, asbestos *Contractor* shall supply protective clothing and respiratory protection for the duration of this operation.

11.3.7 Disposal of all asbestos waste must be conducted in accordance with the Ministry of Environment and Transportation of Dangerous Goods regulations and requirements pertaining to hazardous wastes.

11.3.8 The *Owner* will issue a waste generator number. This waste generator number will appear on all waste transfer manifests.

11.3.9 Disposal must occur at an authorized site in accordance with regulatory requirements.

END OF SECTION 02 82 13
ASBESTOS ABATEMENT

Banff National Park –Environmental Best Management Practices

For Construction Projects

PURPOSE

The following measures are intended to protect the integrity of the environment in the national park. Project proponents (applicants for building permits, and/or project managers), are responsible for their implementation. Additional specific measures required will be outlined in project specific environmental assessment.

Project Coordination

National Parks are special places- Development projects within National Park boundaries will require special attention. Individuals carrying out such projects will require a heightened awareness of environmental stewardship.

Project Manager- person responsible for project coordination on behalf of the proponent and contractors.

Environmental Surveillance Officer (ESO) or **Environmental Monitor (EM) –** assures appropriate level of environmental protection is in place and that compliance/conformance with project environmental commitments are met. They operate independently of the proponent or contractors.

CONDUCT OF WORK

Proponents must notify the Canadian Environmental Assessment Specialist (403-762-1419) of the proposed work schedule at least two weeks in advance so an environmental surveillance officer (ESO) can be appointed, and any surveillance activities accommodated.

If stipulated by the environmental surveillance officer (ESO), a start-up meeting will be held on site involving the proponent, engineering staff, project contractor(s) and the ESO. The meeting is to ensure key construction personnel are aware of the environmental concerns, laws, rules and regulations in Banff National Park.

Periodic on-site meetings with the ESO and the Project Manager may be required during the development phase to discuss environmental concerns. Outstanding problems or significant deviations from approved plans which cannot be resolved at the field level will be presented to the Park Superintendent, or his delegate, for final decision.

No work may commence before all necessary approvals and permits have been obtained from Parks Canada.

Construction workers are required to obtain a National Park Pass. This temporary pass may be obtained from the front office at the Banff National Park administration building.

All contractors must have a valid Business license which may be obtained through contacting the Banff National Park Business Liaison Officer at 403-762-1530.

All park regulations, relevant federal and provincial acts, regulations, guidelines and codes of good practice will apply to all work and activities associated with this project.

Hours of Work: Work hours are generally 7 a.m. and 7 p.m., Monday to Saturday and typically there is no work on Sundays or statutory holidays.

1. SITE ACCESS

Only designated access routes are to be used by construction personnel only.

Vehicle parking is restricted to established roads or identified parking area(s).

It is the responsibility of the contractor to adhere to seasonal vehicle weight restrictions on specific roads such as the Minnewanka loop road. Road weight restrictions are implemented in the spring to minimize damage to road surfaces. The contractor is responsible to contact the ESO to acquire the restriction dates as the windows vary from year to year.

Construction site boundaries must clearly be delineated by flagging or fencing materials and maintained throughout the duration of the project.

Roads, sidewalks and other public accesses are to be maintained with minimal interference unless otherwise noted.

2. SANITARY AND GARBAGE

The contractor shall be required to provide regularly serviced sanitary (toilet) facilities for construction personnel.

The construction site must be maintained in a tidy condition.

All on-site garbage containers used for domestic garbage must be bear-proof.

Food waste is not to be thrown in construction waste bins.

Burning or burial of waste is <u>not permitted</u>.

Trucks hauling excavation fill material and waste are responsible to ensure nothing escapes during transport.

3. WILDLIFE

The contractor shall ensure that there is no harassment of wildlife occurs as a result of the construction activity and that no action is permitted which will attract wildlife to the site.

The contractor will immediately notify Banff Dispatch at 403-762-1470, to inform of any wildlife encounters on or around the work site or crew accommodation.

The contractor is to report observations of wildlife species such as cougar, wolf, lynx, bear, wolverine, and moose, to Banff Dispatch at 403-762-1470 and/or may inform the ESO.

4. CULTURAL RESOURCES

The contractor will immediately inform the ESO and/or the Project manager of any items of historic interest or evidence of archaeological finds that are discovered on the development site (i.e.: old garbage dump sites, cabin sites, etc.). Where possible, the object is to be left in situ until the ESO arrives.

The ESO will provide direction to the Construction Project manager as to the method in which to proceed with the work through consultation with Park Archaeologists.

All historical and prehistoric finds must be protected and will remain the property of Parks Canada.

5. SITE PREPARATION

The work area must be clearly delineated using flagging tape. Use of spray paint is not permitted.

6. TOPSOIL/VEGETATION REMOVAL

The contractor must contact the ESO at least 5 days prior to commencement of tree/vegetation removal. This will enable the ESO time for pre-site inspection.

The topsoil layer in the BNP area is generally very thin. Successful site rehabilitation depends on careful salvaging of the limited topsoil/duff layer.

Existing top soil should be stripped and stock piled separately from subsoil to prevent mixing.

Care must be taken during both grubbing and stripping operations to ensure that the trees and roots on the edge of the clearing limits are not disturbed or damaged. This phase will be closely monitored by the ESO.

In some instances where steep back slopes are involved, grubbing and stripping may not be permitted. Stumps should be cut flush with the ground, and the ground cover left undisturbed to promote slope stability. This will be determined by an on-site inspection by the ESO.

Material encountered below the topsoil layer, which is not suitable for construction purposes may be disposed of at designated location. Arrangements to dispose of the surplus material must be made through discussion with the ESO.

7. CONTAMINATED SOIL

The issue of contaminated soils and disposal practices will normally be identified through the EA process. However, where past and present land use practices have led to soil contamination, certain actions will be required. These include:

Soil testing at the expense of the proponent: Level of contamination will be in accordance with the Canadian Council of Ministers of the Environment guidelines, and acceptable levels will be decided by the park. Minimum acceptable standards for in-Park soil contamination and remediation will be to the "Parkland" level.

Contaminated soil disposal will be at the expense of the proponent. Written proof of disposal of contaminated soils will be required. The closest Class 3 landfill site to Banff National Park is the Francis Cooke Landfill in Exshaw, contact number is 403-673-2708.

8. DISPOSAL OF TREES

Generally, trees are to be cut so that they fall inside the cleared construction site parameters. Tree removal will be detailed on approved site plan or landscaping plan. If not the contractor must contact the ESO for instruction on site specific method of tree disposal

Trees larger than 15 cm (DBH) shall be cut into blocks not to exceed 35 cm. and stockpiled at a designated location for use as firewood and/or if deemed necessary, the contractor is responsible to haul the wood to a pre-approved location.

Trees under 15 cm (DBH) and other woody materials such as stumps, tops, and limbs can be disposed of by chipper and deposited at a designated site; or depending on fire hazard and weather conditions, on-site burning may be permitted through consultation with the ESO and Fire/Vegetation Specialist.

Where possible, every effort will be made to minimize the number of trees cleared. Douglas Fir trees are considered a special resource, and therefore, require consultation with the ESO before removal.

9. CONSTRUCTION MATERIALS

Materials Storage
Construction material shall normally be stored within the confines of the construction site. Under no circumstances may construction materials be stockpiled in the trees along the perimeter of the site or upon any area designated for protection within the site. Off-site storage of materials in undisturbed areas may be allowed only from pre-approval by the ESO.

Trade Waste
Trade waste (construction waste) materials will be disposed of at the designated trade waste area only. There no longer is a trade waste facility in Banff National Park. The nearest trade waste facility is the Francis Cooke Regional Class 3 Landfill located in Exshaw, AB. For more information contact the facility directly at 403- 673-2708.

Toxic/Hazardous Materials
All toxic/hazardous materials will be stored and used in accordance with relevant Federal and Provincial legislation pertaining to these materials. Spill contingency plans and equipment will be on-site, and employees will be aware of such emergency procedures as required. The ESO will be made immediately aware of any and all spills of toxic or hazardous materials. All hazardous wastes will be disposed of at an approved site outside BNP. This material will be disposed of in conformance with all relevant Federal and Provincial legislation and regulations pertaining to the transport and disposition of hazardous wastes.

10. FUEL STORAGE

Permits for on-site storage of fuel or other inflammable liquids must be obtained from the ESO.

Fuel storage and refuelling areas will be designated and must be a minimum of 50 metres from any water body.

The designated storage area will be bermed to enclose 125 % of anticipated storage tank volume. The bermed storage area will be underlain with an impermeable liner. All contaminated rainwater, contained within the berm, will be collected and removed from the park. Other special protection measures may be required to prevent mechanical damage of the tank.

All soil material contaminated during refuelling operations will be collected and disposed of outside BNP at an appropriate facility. Written verification of such disposal will be provided to the ESO.

Spill contingency plans will be developed and appropriate equipment to implement such plans will be in place, in the event of accidental spillage or tank malfunction. Fire protection equipment will be available on-site. The ESO or designate must be contacted immediately to be made aware of any spill. If the spill occurs outside of regular working hours, the contractor is to contact Banff Dispatch at 403-762-1470.

11. EXCAVATING

Excavation areas must be fenced and clearly delineated to restrict access by both people and wildlife. Where possible, work will be conducted in such a manner to minimize leaving open excavations overnight. Any open excavations must be covered securely overnight.

Disposal of surplus excavation material shall be handled in a similar manner to the disposal of surplus stripping material.

It is extremely important in all excavations to ensure that excavated material is not permitted to sluff into the surrounding tree cover, or to bury any plant material that is to be retained. Trees and shrubs on the perimeter of the site can be severely damaged by burial or damage involved in retrieving this material at a later date.

Rocks rolling down steep slopes during excavation or dumping of fill material can severely damage vegetation below. Special attention by equipment operators and extensive downslope protection work may be required.

Careful equipment operation is required to ensure that mechanical damage to trees and surrounding vegetation does not occur. If damage does occur, the contractor will be responsible to replace the vegetation at their own cost.

All equipment operators should be instructed that the operation of construction equipment off-site is not permitted. This applies both to the perimeter of the site, and to any areas within the site that are protected in a natural state.

Park Archaeologists must be informed of any projects in the Park that require excavation. This will be scheduled at the preliminary/design phase of the project. Archaeological/historical concerns will be cleared by Park Archaeological Division prior to initiation of excavation.

Material sources, material storage areas and width of excavation ditches, trucking requirements, etc., will be identified and recognized as part of the cost estimate of the project.

All open excavations will be signed and fenced appropriately in order to minimize hazards to both the general public and to wildlife

12. FOUNDATION AND CONCRETE WORK

Indiscriminate disposal of concrete or concrete residues around the site perimeter is not permitted. A concrete truck cleanout area will be identified for each project through consultation with the ESO. Concrete residues will be disposed of at an approved location outside the Park at the proponent's expense.

13. POLLUTION OF RIVERS AND STREAMS

No rock, silt, cement, grout, asphalt, petroleum product, lumber, vegetation, domestic waste, or any deleterious substance shall be placed or allowed to disperse into any stream, river, pond, storm or sanitary sewer, or other water course.

All fuels, oils, lubricants and other petrochemical products will not be stored within 100 meters of any waterbody (including wetlands).

The crossing of any waterbody (including wetlands) by construction equipment, or the use of such equipment within waterbodies is strictly prohibited unless prior approval has been confirmed through the EA process.

Only approved chemically treated wood will be allowed near water courses. Sawdust and wood scraps will not be allowed to enter waterbodies.

Erosion control measures will be implemented on all construction sites in order to ensure that off-site run-off is minimized and sediments contained within site perimeters. All pumping of water will be subject to approval of the ESO.

Site rehabilitation will be an urgent priority. For construction areas adjacent to watercourses, special protection and / or reclamation measures may be required.

River or streambeds will not be used for borrow materials.

Excavated fill or debris will not be dumped into waterways.

14. POLLUTION PREVENTION AND SPILL REPORTING

Contaminated waste from demolition/construction must be disposed as outlined previously.

Fuel will not be stored on site without pre-approval. Refueling of excavation equipment will occur on hardened surfaces away from water resources only and care taken to avoid spillage.

All fuel, lubricant, oil, hydraulic fluid, or chemical spills must be reported immediately to the Banff Emergency Services (9-1-1). And measures undertaken for immediate containment and clean up by personnel on site. A spill kit of sufficient size to contain and clean up 110% of the site's largest possible fuel/chemical spill must be retained on site. All personnel on site must be aware of the kit, its location and proper use.

Noise and air pollution on site from excavation equipment and trucks will be kept to a minimum by shutting off motors when not in use.

A radon test should be performed before the basement floor is poured so that venting can be installed if required.

Deposit of deleterious substances such as paint, stucco mix, solvents, and petroleum products into street gutters or storm sewers is not permitted.

Equipment and generator plants will operate in accordance with the Alberta Clean Air Act, and Federal Environmental Protection Service emission control regulations/guidelines.

Work schedules and equipment use may be controlled to prevent excessive noise and disturbance to Park visitors. Any such control measures should be specified in the contract documents.

Materials and work site areas will be wetted down as necessary, to prevent blowing dust and debris. Measures will be taken to contain and control and collect windblown debris.

All hazardous and potentially toxic materials used in development projects will be securely stored in a responsible manner during construction activities.

15. SITE REHABILITATION

The contractor must consult with the ESO for the acquisition of site specific native seed mixes and plantings acceptable for use in the park. Native species with low palatability to wildlife are preferred, to avoid enticement and conflict. Fruit bearing trees are generally not acceptable under this present strategy. Trans-plantings may be available from within the park **by permit only.**

Ensure all seed used or sod for lawns and other plantings, such as trees and shrubs, do not transport or carry non-native plants, noxious or restricted weeds. Should a noxious or restricted plant species appear at a future date, the proponent will be responsible for eradication at the direction of Parks Canada.

Fencing must meet "Architectural Motif Guidelines for Banff National Park, and will be designed to prevent wildlife access to lawns and gardens.

Topsoil or other soil (sod) and mulch materials for restoration must be certified free of non-native plant seed.

All trees and plants not designated for removal from a site must be protected. Roots of trees to drip line must be protected during excavation and site grading to prevent disturbance and damage. Unnecessary

traffic, dumping, and storage of materials over root zones can cause soil compaction and suffocation of roots.

Site rehabilitation will receive the highest level of attention. A landscape plan that identifies rehabilitation goals and identifies physical limitations (i.e. water, soil nutrients, suitable species, etc.) to rehabilitation success, will be required.

Any deviation from the Park approved landscape plan will require permission from the Superintendent or designate.

All survey stakes, flagging tape, etc. is to be removed at the completion of the project.

The Construction Project Manager and ESO will inspect the construction site for the following:

-a thorough site cleanup including general litter
-assess that any required topsoil is clean and weed free
-sources of topsoil introduced into the Park require ESO pre-approval
-the use of appropriate plant species and plant seed mix

16. **BLASTING** (see Park Directive #14 *"Control of Explosives"*)

All blasting must conform to existing regulations and be accomplished under the supervision of a licensed blaster.

No blasting will be allowed under water or within 100 meters of spawning beds.

Storage of explosives will be subject to National Parks Regulations.

Fly rock shall not be permitted to damage surrounding vegetation. Use of blasting mats may be required.

17. **ENERGY EFFICIENCY**

To minimize demands placed on existing energy infrastructure, energy efficient and water saving fixtures must be incorporated into any new facility.

Exterior lighting must meet the Parks Canada “Dark Skies” lighting policy.

BANFF DISPATC H NON-EMERGENCY – 403.762.1470

BANFF DISPATCH EMERGENCY – 403.762.4506

HIGHWAY OR TOWN EMERGENCY - 911