PROJECT TITLE	CANADA CENTRE FOR INLAND WATERS 867 LAKESHORE ROAD BURLINGTON, ONTARIO L7R 4A6 LABS, AHUs, AND HEATING UPGRADE
PROJECT NUMBER	R.073578.001
PROJECT DATE	2015-11-04

Division 0 - Procurement and Contracting Requirements

Division 1 - General Requirements

Division 2 - Existing Conditions

Division 3 - Concrete

Division 4 - Masonry

Division 5 - Metals

Division 6 - Wood, Plastics and Composites

Division 7 - Thermal and Moisture Protection

Division 8 - Openings

Division 9 - Finishes

Division 10 - Specialties

Division 11 - Equipment

Division 12 - Furnishings

Division 21 - Fire Suppression

Division 22 - Plumbing

Division 23 - Heating, Ventilating and Air Conditioning

Division 25 - Integrated Automation

Division 26 - Electrical

Division 27 - Communications

Division 28 - Electronic Safety and Security

Appendices

END OF TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 02 81 16 – Hazardous Materials

1.2 DEFINITIONS

.1 Hazardous Materials Report: Information prepared by a specialist consultant hired directly by the Departmental Representative, and is included as information documents related to Project and identified in the Appendices as such, and only as specifically referenced in the Appendices.

.2 Contract Documents: All documents and information of any type and in any form, specifically prepared for use of Contract and as defined in Contractor's Agreement Form.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Status of Hazardous Materials Report: Hazardous Materials Report identified in the Appendices; or any part thereof, are not part of Contract Documents prepared by the Departmental Representative and are made available to Bidder for the purpose of providing Bidder with access to information available to Departmental Representative under the following conditions:

.1 Hazardous Materials Report shall not be considered a representation or warranty that information contained therein is accurate, complete, or appropriate.

.2 Bidder shall interpret and draw conclusions about Hazardous Materials Report and are encouraged to obtain specialist advice with regards to this information.

.3 Departmental Representative assumes no responsibility for such interpretations and conclusions.

.4 Information contained in Hazardous Materials Report may be time sensitive and dates shall be considered when interpreting Hazardous Materials Report.

.5 Bidder may rely upon data contained in Hazardous Materials Report; or parts thereof, which are specifically incorporated into Contract Documents by means of copying, transcribing or referencing, but shall draw their own conclusions from such data and shall not rely on opinions or interpretations contained therein.

.2 Hazardous Materials Report: A Hazardous Materials Report was prepared for this project and is attached as an Appendices, but is not incorporated into the Contract Documents:

.1 Title: Designated Substances and Hazardous Materials Survey, 867 Lakeshore Road, Burlington, ON

.2 Report File Number: 97138.001

.3 Preparation Date: July 10, 2015

.4 Prepared By: Pinchin Environmental Ltd.

.5 Number of Pages: 75

.3 Hazardous Materials Report: A Hazardous Materials Report was prepared for this project and is attached as an Appendices, but is not incorporated into the Contract Documents:

.1 Title: Final Designated Substances and Hazardous Materials Survey, 867 Lakeshore Road, Burlington, ON

.2 Report File Number: 97138.001

.3 Preparation Date: July 15, 2015

.4 Prepared By: Pinchin Environmental Ltd.

.5 Number of Pages: 61

.4 Direct inquiries during Bid period to person identified within the Contracting Authority to receive inquiries; the Departmental Representative will not accept direct enquiries with regards to hazardous materials removal.

Part 2 Products

2.1 USE OF HAZARDOUS MATERIALS REPORT

.1 Information presented in the Hazardous Materials Report was commissioned by the Departmental Representative; recommendations contained in the Hazardous Materials Report were used by the Departmental Representative to assess relative risk of exposure to hazardous materials and the level of involvement of all parties contributing to the Contract Documents.

.2 Information contained in the Hazardous Materials Report may be useful to the Contractor, and is made available for review with no implied or express warranty from the Departmental Representative as to the accuracy or completeness of this Document.

Part 3 Execution

3.1 HAZARDOUS MATERIALS REPORT

.1 A copy of the Hazardous Materials Report is included in the Appendices.

3.2 RESULT OF INSPECTION & AIR MONITORING FOR AIRBORNE FIBRES

.1 Copies of 4 Result of Inspection & Air Monitoring for Airborne Fibres Reports are included in the Appendices.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

.1 Title and description of Work.

.2 Contract Method.

.3 Work by others.

.4 Future work.

.5 Work sequence.

.6 Contractor use of premises.

.7 Owner occupancy.

.8 Partial Owner occupancy.

.9 Owner furnished items.

.10 Alterations to existing building.

1.2 PRECEDENCE

.1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises interior renovation of existing laboratories and mechanical equipment at the Wastewater Technology Centre at the Canada Centre for Inland Waters for Environment Canada, located at 867 Lakeshore Road, Burlington, Ontario L7R 4A6; and further identified as PWGSC Ontario Project Number R.073578.001.

.2 Refer to Section 00 31 00 for information regarding Designated Substances and Hazardous Materials Survey. Required abatement requirements are identified within the Contract Documents.

1.5 CONTRACT METHOD

.1 Construct work under lump sum contract.

.2 Relations and responsibilities between Contractor and subcontractors and suppliers subcontractors assigned by Owner are as defined in Conditions of Contract. Assigned Subcontractors must, in addition:

.1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations thereunder when Contractor is required to furnish such bonds to Departmental Representative.

.2 Purchase and maintain liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required to provide to Departmental Representative.

1.6 COST BREAKDOWN

.1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown by Section aggregating contract amount and a cost breakdown by the following tasks:

.1 CCIW - Trace Metals Field Gear Staging and Storage Room

.2 CCIW - Air Handling Unit - R&D Dual Duct System #1

.3 CCIW - Air Handling Units - Systems 3 and 5

.4 CCIW - Hot Water Heating at WTC

.5 CCIW - Lab H158 Upgrade and Safety Compliance and AHU 44

.6 CCIW - Lab renovation L530 and L527

.7 CCIW - H Wing HVAC Recapitalization (AHU 43)

.8 CCIW - Central Exhaust System and associated work

.2 Show separately cost of equipment purchased exempt from Ontario Retail Sales Tax under your Ontario Sales Tax license number.

.3 Within 48 hours of acceptance of bid submit a list of subcontractors.

1.7 WORK BY OTHERS

.1 The Contractor shall for the purpose of the Ontario Occupational Health and Safety Act and Regulations for Construction Projects, and for the duration of the Work of the Contract:

.1 Assume the role of Constructor in accordance with the Authority Having Jurisdictions.

.2 Agree, in the event of two or more Contractors working at the same time and space at the work site, without limiting the General Conditions GC3.7, to the Departmental Representative's order to:

.1 Assume, as the Constructor, the responsibility for the Departmental Representative's other Contractors.

1.8 CONTRACTOR USE OF PREMISES

.1 Contractor shall limit use of premises for Work, for storage, and for access, to allow;

.1 Partial owner occupancy of the remainder of the building.

.2 Public usage.

.2 Coordinate use of premises under direction of Departmental Representative.

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

1.9 OWNER OCCUPANCY

.1 Owner will occupy remainder of building outside of area of the Work as indicated on Drawings during entire construction period for execution of normal operations.

.2 Cooperate with Departmental Representative in scheduling operations to minimize conflict and to facilitate Owner usage.

.3 CCIW Complex must remain operational at all times with the exception of Laboratory L527, L530, H158, TLMAL Storage Room and new office areas.

.1 Install and make operational new Central Exhaust System to ensure all chemical fume hoods are operational at all times.

.2 Work being undertaken to refurbish or replace existing AHU's and WTC Heating Upgrade must be coordinated with the Departmental Representative in order that services are maintained at all times unless agreed to by the Departmental Representative.

.3 It is critical that HVAC systems remain operational at all times due to the on-going operations of the facilities.

.4 Contractor designated access, parking and laydown areas are identified in the Contract Documents.

1.10 OWNER FURNISHED ITEMS

.1 Owner 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 any observed discrepancies or problems anticipated due to non-conformance with Contract Documents.

.3 Receive and unload products at site.

.4 Inspect deliveries jointly with Owner; 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 ALTERATIONS TO EXISTING BUILDING

.1 Remove and recycle, compost, anaerobic digest, sell material for reuse or dispose of:

.1 All demolition waste resulting from demolition activities as indicated on Drawings that are not designated for reinstallation or turnover to Departmental Representative.

.2 Remove, temporarily store, clean, alter to suit and reinstall:

.1 Two (2) fume hoods located in H158

.3 Provide new openings required in existing construction.

.4 Block in openings where items removed with material and finish to match existing adjoining construction.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 56 00 – Temporary Barriers and Enclosures: Coordination and provision of temporary

1.2 ACCESS AND EGRESS

.1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways and ramps, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.3 USE OF SITE AND FACILITIES

.1 Coordination of Hours of Work: Confine hours of Work on site from 07:00 hours to 18:00 hours, local time, Monday through Friday, and as follows:

.1 Review hours of work with Departmental Representative.

.2 Conduct work undertaken during normal operating hours in a manner that does disrupt Owner's operations.

.3 Arrangements for extended hours to those stated above or for any Work required on Saturdays, Sundays or statutory holidays must be pre-arranged in writing with the Departmental Representative.

.1 Normal operating hours are as follows:

.1	Monday to Friday:	07:00 hours to 18:00 hours
.2	Saturday:	Closed
.3	Sunday:	Closed

.2 No additional compensation will be paid by the Departmental Representative for overtime work where scheduling requires work to be completed on weekends, evenings, or nights unless directed specifically by the Departmental Representative.

.2 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.

.3 Maintain existing services to building and provide for personnel and vehicle access.

.4 Where security is reduced by work provide temporary means to maintain security.

.5 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.

.6 Use only elevators existing in building for moving workers and material.

.1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.

.2 Accept liability for damage, safety of equipment and overloading of existing equipment.

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

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, confirm service interruption identified in Shutdown Schedule with Departmental Representative 1 week and again 48 hours in advance of scheduled shutdown or interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimal. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.3 Provide for personnel, pedestrian and vehicular traffic.

.4 Construct barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

1.6 SPECIAL REQUIREMENTS

.1 Paint public occupied areas Monday to Friday from 18:00 to 07:00 hours only and on Saturdays, Sundays, and statutory holidays.

.2 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Saturdays, Sundays, and statutory holidays.

.3 Work within Corridors 541 and 552 on fifth floor must be coordinated and approved by Departmental Representative prior to any floor or ceiling work commencing in that area as Monitoring & Surveys L520, C.E.C.I.L.I.A ST522, GCMS Instrument Lab L525 and Trace Metals Clean Lab L533 will be shut down during this work. Provide 4 weeks notice to Departmental Representative of commencement of work in this area for coordination of shutdown.

.4 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart.

.5 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.6 Keep within limits of work and avenues of ingress and egress.

.7 Ingress and egress of Contractor vehicles, personnel and visitors at site is limited to locations shown on Drawing A1.00.

.8 Deliver materials outside of peak traffic hours 09:30 to 15:00 unless otherwise approved by Departmental Representative. Deliveries to site or removals from site involving occupation of City of Toronto streets shall not take place without a valid Street Occupancy Permit.

.9 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.

1.7 SECURITY

.1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.

.2 Security clearances:

.1 Personnel and visitors will be checked daily at main Security Control Desk in the A&L Building at start of work shift or visit and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

.1 When signed in, workers and visitors will be allowed unescorted access to A&L Building, Hydraulics Wing, R&D and WTC in accordance with the Security Status of the General Conditions of the Contract.

.3 Security escort:

.1 Personnel employed on this project must be escorted when executing work after normal working hours.

.2 Submit an escort request to Departmental Representative at least 14 days before service is needed. Costs of security escort will be Contractor's responsibility.

.3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort. Cost incurred by late request will be Contractor's responsibility.

.4 Calculation of costs will be based on average hourly rate of security officer for minimum of 8 hours per day for late service request and of 4 hours for late cancellations.

1.8 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is not permitted.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

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

.1 Section 05 12 23 – Structural Steel for Buildings

.2 Section 07 81 00 – Applied Fireproofing

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 conveying systems, mechanical and electrical equipment and systems.

.4 Mill tests and certificates of compliance.

.5 Tests specified to be carried out by Contractor under supervision of Departmental Representative.

.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 48 hours minimum 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

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

- .1 General project coordination procedures
- .2 Coordination of Drawings and Specifications
- .3 Administrative and supervisory personnel
- .4 Electronic project management software systems

.2 Each Subcontractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to specific Subcontractors by Contractor.

1.2 RELATED REQUIREMENTS

.1 Section 01 26 13 – Requests for Information Procedures

.2 Section 01 31 19 – Project Meetings

.3 Section 01 32 16 – Construction Progress Schedule Bar (GANTT) Chart: Construction progress documentation for preparing and submitting Contractor's Construction Schedule.

.4 Section 01 33 00 – Submittal Procedures

.5 Section 01 73 00 – Execution: Coordinating general installation and site engineering services.

.6 Section 01 77 00 – Closeout Procedures

.7 Section 01 91 13 – General Commissioning (Cx) Requirements

.8 Divisions 21, 22 and 23 – Common Work Results: Common work results for fire suppression, plumbing, and heating, ventilating and air conditioning systems

.9 Division 25 – Common Work Results: Common work results for integrated automation.

.10 Divisions 26, 27 and 28 – Common Work Results: Common work results for electrical, communications, and electronic safety and security.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 General Coordination: Coordination that generally applies to all components of the Project Manual as follows:

- .1 Review requirements for inclusion of schedule milestones to ensure timely submittal of Shop Drawings, product data and samples for review by Departmental Representative, and expected time frame for review accounting for possible resubmission without delay consequences.
- .2 Coordinate construction activities as required with Project Schedule to ensure efficient and orderly installation of each part of the Work.

.3 Contractor shall coordinate where Subcontractor's installation of one part of Work is dependent on installation of other components.

.4 Contractor will schedule and coordinate construction activities of other Subcontractors in sequence required to obtain best results. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

.5 Make adequate provisions to accommodate items scheduled for later installation by other Subcontractors, under separate contract or by Contractor's own forces.

1.4 SUBMITTALS

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

.2 Coordination Drawings: Prepare Coordination Drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components or where coordination is required for installation of products and materials fabricated by separate entities:

.1 Indicate relationship of components shown on separate Shop Drawings.

.2 Indicate required installation sequences.

.3 Refer to Divisions 21, 22, 23 and 25 – Mechanically related Sections, and Division 26, 27, 28 and 29 Electrically related Sections for specific coordination drawing requirements for mechanical and electrical installations.

.3 Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site:

.1 Identify individuals and their duties and responsibilities.

.2 List addresses and telephone numbers; including office and alternate telephone numbers.

.3 Provide names, addresses, and telephone numbers of individuals assigned as standbys in absence of individuals assigned to Project.

.4 Post copies of list in Project meeting room, in temporary site office, and by each temporary telephone.

Part 2 PRODUCTS

2.1 ELECTRONIC PROJECT MANAGEMENT SOFTWARE SYSTEMS

.1 Departmental Representative will use Onware project management software to track and manage Project to manage electronic and digital document submissions, requests for interpretation, construction communications, change directives and change orders for the Project; the Departmental Representative's version of software will be considered as the official record for project.

.2 Contractor may use their own electronic management software for managing their in-house operations, but will be required to use Onware, Departmental Representative's version for submission of Requests for Interpretation (RFI's), Progress Claims and other administration documentation.

.3 Contractor shall coordinate mutually agreeable project response timelines for requests for interpretation, Shop Drawing reviews and progress claims for inclusion into Departmental Representative's electronic project management software system.

2.2 ON-SITE DOCUMENTS

.1 Maintain at job site, one copy each of the following:

.1 Contract Drawings
.2 Specifications
.3 Addenda
.4 Reviewed Shop Drawings
.5 Change Orders
.6 Other modifications to Contract
.7 Site test reports
.8 Copy of approved Construction Schedule
.9 Manufacturers' installation and application instructions
.10 Labour conditions and wage schedules
.11 Applicable current editions of municipal regulations and by-laws
.12 Current building codes, complete with addenda bulletins applicable to Place of Work

Part 3 EXECUTION

3.1 ADMINISTRATIVE PROCEDURES

.1 Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of Work. Such administrative activities shall include, but not be limited to, the following:

.1 Preparation of schedules and coordination with Contractor's and other Subcontractor's activities.
.2 Installation and removal of temporary facilities under direction of Contractor not provided by Contractor.
.3 Delivery and processing of submittals for Contractor conveyance to Departmental Representative.
.4 Progress meetings where required by Contractor and Departmental Representative.
.5 Contract acceptance procedures as scheduled by Contractor and as necessary to fulfill Departmental Representative's acceptance procedures.

3.2 COORDINATION

.1 Contractor shall coordinate construction operations included in various Sections of Specifications to verify efficient and orderly installation of each part of the Work.

.2 Contractor shall coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation with Subcontractors as follows:

.1 Scheduling construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

.2 Coordinating installation of different components with Subcontractors to verify maximum accessibility for required maintenance, service, and repair.

.3 Making adequate provisions to accommodate items scheduled for later installation.

.3 Contractor shall prepare memoranda where necessary, for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings:

.4 Coordinate scheduling and timing of required administrative procedures with other construction activities, and activities of other contractors, if any, to avoid conflicts and to verify orderly progress of Work. Administrative activities include, but are not limited to, the following:

.1 Preparation of Contractor’s Construction Schedule

.2 Preparation of Schedule of Values

.3 Installation and removal of temporary facilities and controls

.4 Delivery and processing of submittals

.5 Progress meetings

.6 Pre-Installation Meetings

.7 Project closeout activities

3.3 GENERAL INSTALLATION PROVISIONS

.1 Contractor shall coordinate with installer of each major component to inspect both substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

.2 Contractor shall comply with manufacturer's installation instructions and recommendations, to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents and Specifications.

.3 Contractor shall inspect Products immediately upon delivery and again prior to installation. Reject damaged and defective items and arrange for replacement.

.4 Contractor shall provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

.5 Contractor will supervise Work and ensure the following:

.1 Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to Contractor for final decision.

.2 Install each component during weather conditions and Project status that will ensure best possible results. Isolate each part of completed construction from incompatible Products as necessary to prevent deterioration.

.3 Coordinate temporary enclosures with required inspections and tests, to minimize necessity of uncovering completed construction for that purpose.

.4 Install individual components at standard mounting heights recognized within the industry for particular applications indicated where mounting heights are not indicated. Refer questionable mounting height decisions to Contractor for final decision.

.5 Coordinate construction activities to ensure that no part of Work, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

END OF SECTION

Part 1 GENERAL

1.1 ADMINISTRATIVE

.1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting 4 days in advance of meeting date to Departmental Representative.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

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

.8 Representative of 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 Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors 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 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with Section 01 32 16 – Construction Progress Schedule Bar (GANTT) Chart.

.3 Requirements for project coordination including use of Departmental Representative's electronic project management software in accordance with Section 01 31 13 – Project Coordination.

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

.5 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 – Temporary Facilities.

.6 Site security in accordance with Section 01 56 00.

.7 Health and safety in accordance with Section 01 35 29 – Health and Safety Requirements.

.8 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.9 Owner provided products.

.10 Record drawings and specifications in accordance with Section 01 78 00 – Closeout Submittals.

.11 Maintenance manuals in accordance with Section 01 78 00 – Closeout Submittals.

.12 Take-over procedures, acceptance, warranties in accordance with Section 01 77 00 – Closeout Procedures.

.13 Monthly progress claims, administrative procedures, photographs, hold backs.

.14 Appointment of inspection and testing agencies or firms.

.15 Insurances, transcript of policies.

1.3 PRE-INSTALLATION MEETINGS

.1 Schedule pre-installation meetings required by technical specification Sections making reference to this Section a minimum of 1 week before starting affected work.

.2 Purpose: to discuss coordination and installation requirements for materials and assemblies installed by different Sections of the Work, and to confirm rough-ins, special installation requirements, clearances, material compatibility, protection of installed materials or assemblies, and similar issues.

.3 Attendees:

.1 Contractor’s Representatives: Contractor’s project manager, site superintendent, representatives of Subcontractors affecting construction, and others as necessary.

.2 Departmental Representative's Representatives: as determined by Departmental Representative.

1.4 PROGRESS MEETINGS

.1 During course of Work and two (2) weeks prior to project completion, schedule progress meetings bi-weekly.

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

.3 Notify parties minimum four (4) days prior to meetings.

.4 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 including current Requests For Information.

.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 effect on construction schedule and on completion date.

.12 Other business.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals

1.2 ELECTRONIC COPY

.1 Submit electronic copy of colour digital photography in jpg format, fine resolution.

.2 Submit colour hard copy of digital photographs arranged on 215 mm x 279 mm paper and as follows:

.1 Project Identification: name and number of project and date of exposure indicated in header of each sheet.

.2 Photograph Identification: typewritten room number and description of photograph (i.e. “Office 124, at doorway looking northeast”).

.3 Photograph Size: 100 mm x 150 mm.

.3 Number of viewpoints: minimum twenty-four (24) viewpoints. Locations of viewpoints determined by Departmental Representative.

.4 Frequency: monthly with progress statement and at completion of framing and services before concealment as directed by Departmental Representative.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 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, Certificate of Substantial Performance and Certificate of Completion 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 ten (10) working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.3 Submit Project Schedule to Departmental Representative within five (5) working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

.2 Departmental Representative will review and return revised schedules within 5 working days.

.3 Revise impractical schedule and resubmit within 5 working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 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 Scheduled Shutdowns.
.6 Interior Architecture (Walls, Floors and Ceiling).
.7 Plumbing.
.8 Lighting.
.9 Electrical.
.10 Piping.
.11 Controls.
.12 Heating, Ventilating, and Air Conditioning.
.13 Millwork.
.14 Fire Systems.
.15 Testing and Commissioning.
.16 Supplied equipment long delivery items.
.17 Departmental Representative supplied equipment required dates.

1.6 SHUTDOWN SCHEDULE

.1 Develop Shutdown Schedule from Project Schedule identifying the following:

.1 Shutdowns of mechanical and electrical systems required to complete work within each renovation area.

.2 Anticipated start date and end date of each shutdown including overall anticipated duration of each shutdown.

.3 Identify systems affected by shutdown.

.4 Maintain and update Shutdown Schedule as work progresses.

1.7 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.

.2 Provide four (4) week “lookout schedule” on bi-weekly basis showing scheduled activities including scheduled shutdowns to facilitate the portions of the work in various areas.

.3 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.

1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings specified in Section 01 31 19, 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

.1 Not used.

Part 3 EXECUTION

3.1 NOT USED

.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.

.11 Submit number of hard copies specified for each type and format of submittal and also submit in electronic format as pdf files. Forward PDF, MS Word, MS Excel, MS Project and Autocad dwg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

1.2 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 Where required in the technical specifications Sections, submit shop drawings stamped and signed by professional engineer registered or licensed in Province of Ontario in accordance with Section 01 33 50 – Delegated Design Submittals.

.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 ten (10) 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 Amount. 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, in duplicate, containing:

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

.8 Submissions shall include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .4 Fabrication.
  - .5 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .6 Setting or erection details.
  - .7 Capacities.
  - .8 Performance characteristics.
  - .9 Standards.
  - .10 Operating weight.
  - .11 Wiring diagrams.
  - .12 Single line and schematic diagrams.
  - .13 Relationship to adjacent work.

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

.10 Submit one (1) electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit one (1) electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit one (1) electronic copy 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 accordance with specified requirements.

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

.13 Submit one (1) electronic copy 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 one (1) electronic copy of manufacturer’s 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 one (1) electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

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

.17 Submit one (1) electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

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

.20 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.

.21 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting 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.

1.3 SAMPLES

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

.2 Deliver samples prepaid to Departmental Representative's business address.

.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 Amount. 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.

1.4 MOCK-UPS

.1 Erect mock-ups in accordance with Section 01 45 00.

1.5 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Safety and Insurance Board Experience Report.

1.6 FEES, PERMITS AND CERTIFICATES

.1 Provide authorities having jurisdiction with information requested.

.2 Pay fees and obtain certificates and permits required.

.3 Furnish certificates and permits.

.4 Submit acceptable certificate stating that suspended ceiling systems provide adequate support for electrical fixtures, as required by current bulletin of Electrical Inspection Department of Ontario Hydro.

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 INTENT

.1 The intent of Delegated Design Submittals required by this Section is to account for professional engineering responsibility for design, review and acceptance of components of Work forming a part of permanent Work in accordance with Building Code, and that has been assigned to a design entity other than Departmental Representative including, but not limited to, the following:

.1 Design requiring structural analysis of load bearing components and connections.

.2 Design requiring compliance with fire safety regulations.

.3 Design requiring compliance with life or health safety regulations.

.2 This Section provides standard forms for submittal of Commitment to General Reviews by Architects and Engineers and Letter of General Conformance required complying with requirements of Building Code and design delegated to a professional engineer within technical Specifications Sections.

.3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (for example: crane hoisting, engineered lifts, false Work, shoring, concrete formwork) that would normally form a part of Contractor's scope of Work.

.4 The requirements of this Section are in general conformance with recommended Responsibilities for Engineering Services for Building Projects published by Professional Engineers of Ontario (PEO), with regards to duties of specialty professionals appointed during construction period.

.5 The requirements of this Section do not diminish responsibilities of Departmental Representative's role as Registered Professional of Record; submittals will be used by Departmental Representative to establish that Work is substantially performed and allow declaration for Assurance of Professional Review and Compliance required by the Building Code by the Registered Professional of Record.

1.2 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures: Submission of required supporting documentation by Delegated Design Professional Engineers.

.2 Section 01 41 00 – Reference Standards: Requirements for governing Building Codes and Standards.

.3 Section 01 45 00 – Quality Control: Quality control and assurance responsibilities for design of shop and site fabricated components.

.4 Section 07 05 53 – Fire and Smoke Assembly Design Requirements and Identification: Quality control and assurance responsibilities for preparation of Engineered Judgements of fire resistive materials required for the project.

.5 Technical Specifications Sections make specific reference to delegated design requirements described in this Section.

1.3 DEFINITIONS

.1 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and Shop Drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the Departmental Representative.

.2 Commitment to General Reviews by Architects and Engineers and Letter of General Conformance: Documents prepared by the delegated design professional engineer as recommended by PEO guidelines for providing general review of construction by the professional engineer.

.3 Engineered Judgement for Fire Rated Assembly Components: A written proposal submitted by manufacturer to the Authority Having Jurisdiction arising from a variation that modifies the manufacturer's standard listed assemblies and details to account for actual site conditions and as follows:

.1 Engineered Judgements are prepared by a certified specialist that has completed a sanctioned examination and has professional accreditation in the assemblies affected by site conditions different than those forming standard listed assemblies and details.

.2 Person issuing Engineered Judgement must be directly employed by the manufacturer and have direct experience in the preparation of Engineered Judgements required for the Project.

.3 Person signing the Engineered Judgement must be a Certified Fire Protection Specialist; Engineered Judgements do not require signature and seal of a professional engineer unless required by the Authority Having Jurisdiction.

1.4 REFERENCE STANDARDS

.1 Professional Engineers of Ontario (PEO:

.1 PEO Professional Engineers Reviewing Work Prepared by another Professional Engineer

.2 PEO Use of the Professional Engineer's Seal

1.5 SUBMITTALS

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

.2 Informational Submittals: Provide the following submittals during the course of the Work:

.1 Commitment to General Reviews by Architects and Engineers: Submit a signed and completed Engineers, Architects and Building Officials (EABO) standard form Commitment to General Review by Architects and Engineers to Consultant for submission to Authority Having Jurisdiction prior to starting Work requiring design and seal of a professional engineer.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Record Documentation: Submit the following required information in accordance with Section 01 78 00 – Closeout Submittals before application for Substantial Performance of the Work:

.1 Letter of General Conformance: Submit a signed and sealed Letter of General Conformance on company letterhead addressed to Departmental Representative in accordance with format in Appendix A attached to the end of this Section on completion of Work requiring design and seal of a professional engineer.

.2 Engineered Judgements: Submit Product literature and compliance certificates as required by Section 07 84 00, and include any required Engineered Judgements that became necessary to account for installation conditions that are different than tested assemblies.

Part 2 PRODUCTS

2.1 DELEGATED DESIGN

.1 Performance and Design Criteria: Provide Products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents.

.2 Submit a written request for additional information to Departmental Representative if criteria indicated within documents are not sufficient for the Contractor to perform services or certification required.

.3 Delegated design will be required for elements designed by a specialty professional, which may include:

.1 Elements normally fabricated off-site

.2 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site (for example: open web steel joists, wood trusses, combination wood and metal or plywood joists, prefabricated wood or metal buildings, noise and vibration isolation devices, elevators).

.3 Elements requiring civil engineering, not normally a part of scope of services performed by architectural; structural; mechanical; electrical; or geotechnical disciplines of Departmental Representative (for example: structural steel connection design, steel deck design).

1 Execution

2.2 IMPLEMENTATION

.1 Include Summary of Work described in technical specification section as a part of the required [Model Schedule S-B] [Letter of Commitment] [Commitment to General Reviews by Architects and Engineers].

.2 Prepare required submittals and present to Consultant within sufficient time to allow for Consultant’s detailed review and acceptance.

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APPENDIX A

LETTER OF GENERAL CONFORMANCE - ONTARIO

[Date]

DIALOG®
2 Bloor Street East, Suite 1000
Toronto, Ontario M4W 1A8

Attention: [Consultant's Registered Professional of Record]

Re: Letter of General Conformance for Delegated Design of [System of Component of Work]

[Name of Project]
[Project Number]
[City, Province]

I hereby give assurance that I have fulfilled my obligations for field review as outlined by previously submitted Engineers, Architects and Building Officials (EABO) standard form Commitment to General Review by Architects and Engineers and as required by the Ontario Building Code.

During the course of construction of this project, personnel from our firm visited the site in order to carry out general review in accordance with the performance standards of the Professional Engineers of Ontario and the requirements of the Ontario Building Code. On the basis of our review, we have determined that the construction has been carried out in general conformity with the [specify description as appropriate to define area of review for delegated design undertaken] as required by the Contract Documents which formed the basis for the issuance of the building permit.

Retained Professional Engineer

Signature

Date

(Apply seal)

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA): Canada

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

.2 National Building Code 2010 (NBC):

.1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.

.3 National Fire Code 2010 (NFC):

.1 NFC 2010, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.

.4 Province of Ontario:

.1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and Regulations for Construction Projects, O. Reg. 213/91 as amended.

.2 O. Reg. 490/09, Designated Substances.

.3 Workplace Safety and Insurance Act, 1997.

.4 Municipal statutes and authorities.

.5 Treasury Board of Canada Secretariat (TBS):

.1 Treasury Board, Fire Protection Standard April 1, 2010 www.tbs-sct.gc.ca/pol/doc-eng.aspx ?id=17316&section=text.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.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 Measures and controls to be implemented to address identified safety hazards and risks.

.3 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.3 prior to commencement of work. The plan shall be coordinated with, and integrated into, the existing Building's Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Building's Emergency Procedures and Evacuation Plan. Deliver the Fire Safety Plan to the Departmental Representative not later than 14 days before commencing work.

.4 Contractor's and Subcontractors' Safety Communication Plan.

.5 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations. Coordinate plan with existing Facility's Emergency Response requirements and procedures provided by Departmental Representative.

.6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within ten (10) days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within five (5) days after receipt of comments from Departmental Representative.

.7 Departmental Representative'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.

.8 Submit names of personnel and alternates responsible for site safety and health.

.9 Submit records of Contractor's Health and Safety meetings when requested.

.10 Submit one (1) electronic copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative weekly.

.11 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.

.12 Submit copies of incident and accident reports.

.13 Submit Material Safety Data Sheets (MSDS).

.14 Submit Workplace Safety and Insurance Board (WSIB) – Experience Rating Report.

1.3 FILING OF NOTICE

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

.2 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.4 WORK PERMIT

.1 Obtain Hot Work Permit from Property Manager.

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 Departmental Representative prior to commencement of Work.

1.7 REGULATORY REQUIREMENTS

.1 Comply with the Acts and regulations of the Province of Ontario.

.2 Comply with specified standards and regulations to ensure safe operations at site.

1.8 PROJECT/SITE CONDITIONS

.1 Work at site may involve contact with:

.1 Silica in concrete and concrete block.

.2 Mercury in switches, fluorescent light tubes and thermostats.

.3 Asbestos in pipe covering, vinyl composition tiles, transite panels, sealants, mastics, pargings and BUR roof felt.

.4 Lead in paint and emergency lighting batteries.

1.9 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 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns either accepting or requesting improvements.

.3 Relief from or substitution for any portion or provision of minimum Health and Safety standards specified herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.10 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990 Chapter 0.1, as amended.

1.11 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.

.3 Where applicable the Contractor shall be designated "Constructor", as defined by Occupational Health and Safety Act and Regulations for Construction Projects for the Province of Ontario.

1.12 UNFORSEEN HAZARDS

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

.2 Follow procedures in place for Employees Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.

1.13 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities associated with abatement of lead and asbestos containing materials.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.14 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 of Ontario, and in consultation with Departmental Representative.

.1 Contractor's Safety Policy.

.2 Constructor's Name.

.3 Notice of Project.

.4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).

.5 Ministry of Labour Orders and reports.

.6 Occupational Health and Safety Act and Regulations for Construction Projects for Province of Ontario.

.7 Address and phone number of nearest Ministry of Labour office.

.8 Material Safety Data Sheets.

.9 Written Emergency Response Plan.

.10 Site Specific Safety Plan.

.11 Valid certificate of first aider on duty.

.12 WSIB "In Case of Injury At Work" poster.

.13 Location of toilet and cleanup facilities.

1.15 CORRECTION OF NON-COMPLIANCE

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

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

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

1.16 POWDER ACTUATED DEVICES

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

1.17 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.

.2 Assign responsibility and obligation to Health and Safety Coordinator or Competent Supervisor to stop or start Work when, at Health and Safety Coordinator's or Competent Supervisor's discretion, it is necessary or advisable for reasons of health or safety. Departmental Representative may also stop Work for health and safety considerations.

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 GENERAL

.1 This Section specifies general requirements and procedures for fire safety. Additional requirements may be specified in individual sections elsewhere in specifications.

1.2 REPORTING FIRES

.1 The Departmental Representative will co-ordinate arrangements for the Contractor to be briefed at the pre-construction meeting concerning Building's fire safety protocol.

.2 Building Manager will supply a copy of "Fire Safety Emergency Evacuation Plan" in effect for this building. Contractor shall comply with outlined fire safety requirements.

.3 Know location of nearest fire alarm box and telephone, including emergency phone number.

.4 Report immediately all fire incidents to Fire Department as follows:

.1 Activate nearest fire alarm box; or

.2 Telephone.

.5 Person activating fire alarm box will remain at box to direct Fire Department to scene of fire.

.6 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify the location.

1.3 FIRE WATCH

.1 Appoint a Fire Watch at locations where welding and soldering, torching or roofing is to take place.

.2 A dedicated Fire Watch is not required. A competent person from the workforce on site may be assigned as Fire Watch for duration of work.

.3 Assign a person who is knowledgeable in the correct use of fire extinguishers on the project.

.4 Have work inspected by the Fire Watch up to 4 hours after work stoppage for each work period.

1.4 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

.1 Fire protection and alarm system will not be:

.1 Obstructed;

.2 Shut-off; or

.3 Left inactive at end of working day or shift.

.2 Fire hydrants, standpipes and hose systems will not be used for other than fire-fighting purposes unless authorized by Departmental Representative.

.3 Provide and maintain free access to fire extinguishing equipment. Maintain exit facilities. Keep means of egress free from materials, equipment and obstructing.

1.5 FIRE EXTINGUISHERS

.1 Supply fire extinguishers, as necessary to protect work in progress and contractor's physical plant on site.

1.6 INSTALLATION AND/OR REPAIR OF ROOF TO INCLUDE CONTRACTORS PHYSICAL PLANT AT SITE

.1 Ensure personnel use and take precautions as follows:

.1 Use kettles equipped with thermometers or gauges in good working order.

.2 Locate kettles in safe place outside of building. Locate to avoid danger of igniting combustible material.

.3 Maintain continuous supervision while kettles are in operation and provide metal covers for kettles to smother any flames in case of fire. Fire extinguishers shall be provided as required in 1.5.

.4 Prior to start of work, demonstrate container capacities to Departmental Representative.

.5 Use only glass fibre roofing mops.

.6 Used roofing mops will not be left unattended on roof and shall be stored away from building and combustible materials.

.7 All roofing materials will be stored in location no closer than 3 m to any structures.

.8 Comply with requirements of NFC 5.6.1.7.

1.7 BLOCKAGE OF ROADWAYS

.1 Advise Departmental Representative of any work that would impede fire apparatus response. This includes violation of minimum required overhead clearance.

1.8 SMOKING PRECAUTIONS

.1 Smoking is not permitted within areas of work or site storage.

1.9 RUBBISH AND WASTE MATERIALS

.1 Rubbish and waste materials are to be kept to a minimum.

.2 Burning of rubbish is prohibited.

.3 Remove all rubbish from work site at end of work day or shift or as directed.

.4 Storage:

.1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.

.2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove from site daily or at the end of each shift.

1.10 FLAMMABLE AND COMBUSTIBLE LIQUIDS

.1 Handling, storage and use of flammable and combustible liquids are to be governed by the current National Fire Code of Canada.

.2 Flammable and combustible liquids such as gasoline, kerosene and naphtha will be kept for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission of local Building Manager.

.3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.

.4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat-producing devices.

.5 Flammable liquids having a flash point below 38°C such as naphtha or gasoline will not be used as solvents or cleaning agents.

.6 Flammable and combustible waste liquids, for disposal, will be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum and Fire Department is to be notified when disposal is required.

1.11 HAZARDOUS SUBSTANCES

.1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, will be in accordance with National Fire Code of Canada.

.2 Obtain from local Building Manager a "Hot Work" permit for work involving welding, burning or use of blow torches and salamanders, in buildings or facilities.

.3 When Work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the local Building Manager. Contractors are responsible for providing fire watch service for work on a scale established and in conjunction with Building Manager at pre-construction meeting.

.4 Where flammable liquids, such as lacquers or urethanes are to be used, proper ventilation will be assured and all sources of ignition are to be eliminated. Building Manager is to be informed prior to and at cessation of such work.

1.12 WELDING, BURNING AND CUTTING

.1 Contractor performing work of this Section must notify Departmental Representative in advance of commencing work.

.2 Use non-combustible shields for electric and gas welding or cutting executed within 3 m of combustible material or in occupied spaces.

.3 Place cylinders supplying gases as close to work as possible. Secure cylinders in upright position, free from exposure to sun or high temperature.

.4 Locate fire extinguishing equipment near all welding, cutting and soldering operations.

.5 Contractor's mechanics shall be properly equipped with required protective clothing, including goggles or welding hood or face mask, gloves, etc.

.6 Contractor is responsible for the protection of his work and the Departmental Representative's property.

.7 Provide Fire Watch on standby with approved fire extinguisher while burning or welding is in progress.

1.13 QUESTIONS AND/OR CLARIFICATIONS

.1 Direct any questions or clarification on Fire Safety in addition to above requirements to local Building Manager.

1.14 FIRE INSPECTION

.1 Site inspections by Building Manager will be coordinated through Departmental Representative.

.2 Allow local Building Manager unrestricted access to work site.

.3 Co-operate with Building Manager during routine fire safety inspection of work site.

.4 Immediately remedy all unsafe fire situations observed by Building Manager.

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 AND CODES

.1 Perform Work in accordance with National Building Code of Canada (NBC) 2010, National Fire Code of Canada (NFC) 2010 and Ontario Building Code (OBC) 2012, including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

.1 Stop work immediately and notify Departmental Representative if materials which may contain designated substances or PCB's, other than those identified in Section 00 31 26 – Existing Hazardous Material Information are discovered in course of work.

1.3 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions.

1.4 IAQ - INDOOR AIR QUALITY

.1 Comply with CSA-Z204-94(R1999), Guideline for Managing Indoor Air Quality in Office Buildings and CSA B651-12.

1.5 ACCESSIBLE DESIGN

.1 Comply with CSA B651-12, Accessible Design for the Built Environment, unless specified otherwise. In any case of conflict or discrepancy between the building codes and CSA B651, the requirements of CSA B651 shall apply.

1.6 STATISTICAL INFORMATION

.1 Provide statistical information to Departmental Representative:

.1 Within ten working days after March 31 and September 30 occurring between commencement of work and final completion

.2 Within ten working days after final completion.

.2 Include in statistical information:

.1 Statement of total person days of labour used on site in performance of contract, including labour provided under sub-contracts.

.2 Estimate of total value in dollars of material delivered to site and installed, including material provided and installed under sub-contracts.

.3 This information is required by Government of Canada solely to provide statistics that will aid in assessing socio-economic benefits of this project.

1.7 TAXES

.1 Pay applicable Federal, Provincial and Municipal taxes.

1.8 EXAMINATION

.1 Examine existing conditions and determine conditions affecting work.

.2 Conduct concrete floor moisture testing using Calcium Chloride moisture tests.

.1 Submit test results to Departmental Representative for approval prior to installing any flooring. Conduct one test per 100 m^2 of area being covered.

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 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mock-ups.

.4 Mill tests.

.5 Equipment and system adjust and balance.

1.2 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

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

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

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

1.3 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work under Section 01 29 83, above and beyond those required of the Contractor. Cost of such services will be borne by 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.

1.4 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.

1.5 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

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

1.7 REPORTS

.1 Submit one (1) electronic copy of inspection and test reports to Departmental Representative and Contractor.

.2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested and to authorities having jurisdiction as required by authority having jurisdiction.

1.8 TESTS AND MIX DESIGN

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

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Departmental Representative and may be authorized as recoverable.

1.9 MOCK-UPS

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

.2 Construct in all locations as specified in specific Section.

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

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

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

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

1.10 MILL TESTS

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

1.11 EQUIPMENT AND SYSTEMS

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

.2 Submit Commissioning Documentation in accordance with Section 01 91 13.

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 SECTION INCLUDES

.1 Temporary utilities.

1.2 SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.4 WATER SUPPLY

.1 Departmental Representative will provide continuous supply of potable water for construction use.

.2 Departmental Representative will pay for utility charges at prevailing rates.

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 non-flameless type. Solid fuel salamanders are not permitted.

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

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

.4 Maintain temperatures of minimum 10°C in areas where construction is in progress.

.5 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.

.6 Permanent heating system of building, may not be used.

.7 Departmental Representative will pay utility charges.

.8 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.

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

1.6 TEMPORARY POWER AND LIGHT

.1 Departmental Representative will pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts, 30 amps.

.2 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor.

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

.4 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

1.7 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

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Office and sheds.

.3 Parking.

.4 Project identification.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.

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

.2 Canadian Standards Association (CSA International)

.1 CSA A23.1-09/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-Z321-96(R2006), Signs and Symbols for the Occupational Environment, withdrawn but still available from CSA, CCOHS and Techstreet.

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 Indicate use of supplemental or other staging area.

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

.4 Remove from site all such work after use.

1.4 HOISTING

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

.2 Hoists/cranes shall be operated by qualified operator.

.3 All hoisting shall be limited between 18:00 to 7:00 hours

1.5 ELEVATORS

.1 Existing elevators may not be used by construction personnel and transporting of materials.

1.6 SITE STORAGE/LOADING

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

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

1.7 CONSTRUCTION PARKING

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

.2 Provide and maintain adequate access to project site.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

.4 Clean construction access routes and marshalling areas where used by Contractor's equipment.

1.8 OFFICES

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

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

.3 Subcontractors may not provide their own offices.

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

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

1.10 SANITARY FACILITIES

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

.2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

.3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Departmental Representative.

1.11 CONSTRUCTION SIGNAGE

.1 Provide and erect, within three (3) weeks of signing Contract, a project sign in a location designated by Departmental Representative.

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

.3 Provide project identification site sign comprising foundation, framing, and one (1) 1200 x 2400 mm signboard as detailed and as described below.

.1 Foundations: 15 MPa concrete to CAN/CSA-A23.1/A23.2 minimum 200 mm diameter x 900 mm deep.

.2 Framework and battens: SPF, pressure treated minimum 89 x 89 mm.

.3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.

.4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CGSB 1-GP-189.

.5 Fasteners: hot-dip galvanized steel nails and carriage bolts.

.6 Vinyl sign face: printed project identification, self-adhesive, vinyl film overlay, supplied by Departmental Representative.

.4 Locate project identification sign as directed by Departmental Representative and construct as follows:

.1 Build concrete foundation, erect framework, and attach signboard to framing.

.2 Paint all surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.

.3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.

.5 Direct requests for approval to erect a Consultant/Contractor signboard to Departmental Representative. For consideration general appearance of Consultant/Contractor signboard must conform to project identification site sign. Wording shall be in both official languages.

.6 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN/CSA-Z321.

.7 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.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide access 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.

1.13 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.

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 SECTION INCLUDES

.1 Barriers.

.2 Environmental Controls.

.3 Traffic Controls.

.4 Fire Routes.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.

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

.2 Canadian Standards Association (CSA):

.1 CSA-O121-08 (T2013), Douglas Fir Plywood.

1.3 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.4 HOARDING

.1 Erect temporary site enclosure using modular freestanding fencing: galvanized, minimum 1.8 m high, chain link or welded steel mesh, pipe rail as required by Contractor for securing site office and marshalling area. Provide one pedestrian entrance. Equip gates or access points with locks and keys. Maintain fence in good repair.

1.5 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around open shafts and open edges of floors.

.2 Provide as required by governing authorities having jurisdiction.

1.6 DUST TIGHT SCREENS

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.7 ACCESS TO SITE

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

1.8 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 the public. Comply with requirements of Section 01 52 00.

1.9 FIRE ROUTES

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

.2 Protect fire alarm systems.

.3 Maintain full access to emergency exits.

1.10 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.

1.11 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 three (3) days prior to installation.

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

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 SECTION INCLUDES

.1 Product quality, availability, storage, handling, protection, and transportation.

.2 Manufacturer's instructions.

.3 Quality of Work, coordination and fastenings.

.4 Existing facilities.

1.2 REFERENCES

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

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

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

.4 The 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.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

1.3 QUALITY

.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any 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 Amount or Contract Time.

1.5 METRIC SIZED MATERIALS

.1 SI metric units of measurement are used exclusively on the drawings and in the specifications for this project.

.2 The Contractor is required to provide metric products in the sizes called for in the Contract Documents except where a valid claim can be made that a particular product is not available on the Canadian market.

.3 Claims for exemptions from use of metric sized products shall be in writing and fully substantiated with supportive documentation. Promptly submit application to Departmental Representative for consideration and ruling. Non-metric sized products may not be used unless Contractor's application has been approved in writing by the Departmental Representative.

.4 Difficulties caused by the Contractor's lack of planning and effort to obtain modular metric sized products which are available on the Canadian market will not be considered sufficient reasons for claiming that they cannot be provided.

.5 Claims for additional costs due to provision of specified modular metric sized products will not be considered.

1.6 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

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

.9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.7 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

.2 Transportation cost of products supplied by Departmental Representative will be paid for by Departmental Representative. Unload, handle and store such products.

1.8 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Amount or Contract Time.

1.9 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.10 CO-ORDINATION

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.11 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.

1.12 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

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

1.13 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.

1.14 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.

1.15 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.

1.16 PROTECTION OF WORK IN PROGRESS

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

1.17 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.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

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.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 Owner 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 Owner 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.

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

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

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

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

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

.10 Submit proposed materials, finishes and installation method for patching to Departmental Representative for acceptance, prior to patching.

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

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

.13 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00, full thickness of the construction element.

.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, recycling, composting, and anaerobic digestion in accordance with Section 01 74 20.

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 SECTION INCLUDES

.1 Progressive cleaning.

.2 Final cleaning.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.

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

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

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

.5 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 20.

.6 Remove waste material and debris from site and deposit in waste container at end of each working day.

.7 Dispose of waste materials and debris off site.

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

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

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

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

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

1.3 FINAL CLEANING

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

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

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

.4 Remove waste products and debris other than that caused by Owner or other Contractors.

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

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

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

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

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

.10 HEPA vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

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

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

.14 Remove dirt and other disfiguration from exterior surfaces.

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

.16 Sweep and wash clean paved areas.

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

.18 Clean roofs, downspouts, and drainage systems.

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 CONSTRUCTION & DEMOLITION WASTE

.1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 75% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.

.2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.

.1 Provide facilities for collection, handling and storage of source separated wastes.

.2 Source separate the following waste:

.1 Brick and portland cement concrete.

.2 Corrugated cardboard.

.3 Wood, not including painted or treated wood or laminated wood.

.4 Gypsum board, unpainted.

.5 Steel.

.6 Items indicated in Section 02 41 99 - Demolition.

.3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.

.1 Indicate how material being removed from the site will be reused, recycled, composted or anaerobically digested using Section 02 42 93, Deconstruction and Waste Products Workplan Summary.

.4 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.

1.2 WASTE PROCESSING SITES

.1 Province of: Ontario.

.1 Ministry of Environment and Energy, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5.

.2 Telephone: 800-565-4923 or 416-323-4321.

.3 Fax: 416-323-4682.

.2 Recycling Council of Ontario: 215 Spadina Avenue, #225, Toronto, ON, M5T 2C7.

.1 Telephone: 416-657-2797

.2 Fax: 416-960-8053

.3 Email: rco@rco.on.ca.

.4 Internet: http://www.rco.on.ca/.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1 Government Chief Responsibility for the Environment.

Province	Address	General	Fax Inquiries
Ontario	Ministry of Environment and Energy 135 St Clair Avenue West Toronto, ON M4V 1P5	(416) 323-4321 (800) 565-4923	(416) 323-4682
	Environment Canada Toronto, ON	(416) 734-4494	

END OF SECTION

Part 1 GENERAL

1.1 INSPECTION AND DECLARATION

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

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

.2 Request Departmental Representative's Inspection.

.2 Departmental Representative's 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 Certificates required by Fire Commissioner have been submitted.

.5 Operation of systems have been demonstrated to Owner's personnel.

.6 Work is complete and ready for final inspection.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative 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 20 – Construction/Demolition.

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 SECTION INCLUDES

.1 As-built, samples, and specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Spare parts, special tools and maintenance materials.

.6 Warranties and bonds.

.7 Final site survey.

1.2 SUBMISSION

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

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

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

.4 Two (2) weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four (4) final copies of maintenance manuals and commissioning documentation in English.

.5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.6 If requested, furnish evidence as to 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.

1.3 FORMAT

.1 Organize data in the form of an instructional manual.

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

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

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

.5 Arrange content by systems 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 and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format on CD-ROM or DVD-ROM.

1.4 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

.2 Date of submission;

.3 Name, addresses, and telephone numbers of Contractor with name of responsible parties;

.4 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 clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

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

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

.6 Training: Refer to Section 01 79 00 – Demonstration and Training.

1.5 AS-BUILTS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative review and reference throughout the progress of the Work one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Amendments and addenda.

.4 Change Orders and other modifications to the Contract.

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

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

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

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

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

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

.6 Turn one set, paper copy and electronic copy, of AS-BUILT drawings and specifications over to Departmental Representative on completion of work. Submit files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

.7 If project is completed without significant deviations from Contract drawings and specifications submit to Departmental Representative one set of drawings and specifications marked "AS-BUILT".

1.6 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black 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: legibly mark each item to record actual construction, including:

- .1 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

- .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
- .2 Changes made by Amendments and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications Sections.

1.7 EQUIPMENT AND SYSTEMS

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

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01 45 00 and 01 91 13.

.15 Additional requirements: As specified in individual specification sections.

1.8 MATERIALS AND FINISHES

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

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

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

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

1.9 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification Sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.10 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.11 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.12 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 Store paints and freezable materials in a heated and ventilated room.

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

1.13 WARRANTIES

.1 Separate each warranty 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 executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Certificate of Substantial Performance is determined.

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

.6 Co-execute submittals when required.

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

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 SECTION INCLUDES

.1 Procedures for demonstration and instruction of equipment and systems to Owner's O&M personnel.

.2 O&M personnel includes property facility manager, building operators, maintenance staff, security staff and technical specialists, as applicable.

1.2 DESCRIPTION

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of final inspection.

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

1.3 QUALITY CONTROL

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

.2 Submit training schedule of time and date for demonstration and training of each item of equipment and each system in accordance with the training plan four weeks prior to designated dates, for Departmental Representative's approval.

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

.4 Report shall give time and date of each demonstration and training, with list of persons present.

1.4 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation in accordance with individual specifications Sections.

.2 Testing, adjusting, and balancing has been performed in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC and equipment and systems are fully operational.

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

1.5 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated O&M personnel are present.

1.6 DEMONSTRATION AND INSTRUCTIONS

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

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

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

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

1.7 TIME ALLOCATED FOR INSTRUCTIONS

.1 Ensure amount of time required for instruction of each item of equipment or system as follows:

.1 Sections 23 21 13.02, 23 21 23, 23 36 00, 23 44 00, 23 52 00, 23 57 00, 23 73 10, 23 73 11, 23 82 39 and 23 84 13 - Heating Plant: 16 hours of instruction.

.2 Sections 23 21 23, 23 33 15, 23 33 16, 23 34 00, 23 36 00, 23 44 00, 23 73 10 and 23 73 11 - Ventilation System: 16 hours of instruction.

.3 Section 25 01 12 - Control System: as specified in Section 25 01 12.

.4 Section 22 42 00 – Commercial Plumbing System: 8 hours of instruction.

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 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.

.2 BMM - Building Management Manual.

.3 Cx - Commissioning.

.4 EMCS - Energy Monitoring and Control Systems.

.5 O&M - Operation and Maintenance.

.6 PI - Product Information.

.7 PV - Performance Verification.

.8 TAB - Testing, Adjusting and Balancing.

1.2 RELATED REQUIREMENTS

.1 Section 01 91 16 – Facility Commissioning - Mechanical

1.3 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 Contractor to cooperate and coordinate with the 3rd party Commissioning Authority, hired by the Departmental Representative, for verifying the performance of mechanical and electrical systems related to the project. Contractor to carry all costs associated to such performance verification.

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

.4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

1.4 COMMISSIONING OVERVIEW

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

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

.3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built 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.

.4 Departmental Representative will issue Certificate of Substantial Performance when:

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

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.5 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.

1.6 PRE-CX REVIEW

.1 Before Construction:

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

.1 Adequacy of provisions for Cx.

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

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

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

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

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

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

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

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

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

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

1.7 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.

1.8 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.1 Submit no later than four (4) weeks after award of Contract:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least eight (8) weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least eight (8) weeks prior to start of Cx.

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

1.9 COMMISSIONING DOCUMENTATION

.1 Departmental Representative to review and approve Cx documentation.

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

1.10 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.

.2 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.

1.11 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: Section 01 32 16 and as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage, Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

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

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

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

.6 Meeting will be chaired by Cx Agent, who will record and distribute minutes.

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

1.12 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.

1.13 WITNESSING OF STARTING AND TESTING

.1 Provide fourteen (14) days notice prior to commencement.

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

.3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.14 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for approval by Departmental Representative.

.3 Arrange for Departmental Representative to witness tests.

.4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.

.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.

1.15 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 approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.

.3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.

.1 Rejected equipment to be remove from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.16 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.17 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 Departmental Representative for approval 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.

1.18 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.

1.19 START OF COMMISSIONING

.1 Notify Departmental Representative at least twenty-one (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.

1.20 INSTRUMENTS / EQUIPMENT

.1 Submit to Departmental Representative for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.21 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual 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.

1.22 WITNESSING COMMISSIONING

.1 Departmental Representative to witness activities and verify results.

1.23 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 five (5) days of test and with Cx report.

1.24 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 before issuance of the Certificate of Substantial Performance, using, if necessary, simulated thermal loads.

1.25 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.

1.26 EXTENT OF VERIFICATION

.1 Provide manpower and instrumentation to verify up to 100% of reported results, unless specified otherwise in other Sections.

.2 Number and location to be at discretion of Departmental Representative.

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

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

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

1.27 REPEAT VERIFICATIONS

.1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:

.1 Verification of reported results fail to receive Departmental Representative's approval.

.2 Repetition of second verification again fails to receive approval.

.3 Departmental Representative deems Contractor's request for second verification was premature.

1.28 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.

1.29 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.

1.30 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.

1.31 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.

1.32 TRAINING

.1 In accordance with Section 01 79 00 – Demonstration and Training.

1.33 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.34 OCCUPANCY

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

1.35 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Departmental Representative.

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

1.36 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:

.4 Unless otherwise specified actual values to be within +/-2% of recorded values.

1.37 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Departmental Representative 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

Part 1 GENERAL

1.1 SUMMARY

.1 Conform to:

.2 Section 3, SACC Manual-- General Conditions of Contract,

.3 Section 4, SACC Manual—Supplemental General Conditions,

.4 Comply with Section 01 91 13 (General Commissioning Requirements), and

.5 Comply with Division 22, 23 and 25 requirements and documents referred to herein.

.2 Acronyms:

.1 Validate (for tests and demonstrations): to authenticate successful performance of systems and equipment, or record deficiencies; after deficiencies are repaired, to confirm that there has been a successful demonstration of the same systems and equipment; the authentication of those tests become references for the Departmental Representative's certification.

.2 Witness: The Commissioning Authority will observe as required and record summary of systems and equipment test results.

.3 BAS: Building Automation System.

.4 TAB: Testing, Adjusting and Balancing.

.5 Commissioning Authority: An agent in charge of the process of assuring that all systems and components of a building or industrial plant are designed, installed, tested, operated, and maintained according to the operational requirements of the Departmental Representative or Client.

.6 Independent Third Party Agent: An outside person or business specialized in the installation and testing of building systems and equipment who is retained by the Contractor or Departmental Representative.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Guideline 1.1-2007 Technical Requirements for the Commissioning Process

.2 Canadian Standards Association (CSA):

.1 CSA Z320-11, Building Commissioning Standard & Check Sheets

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.3 DOCUMENTS

.1 Documents will be governed in the order specified in Division 1, in case of discrepancies or conflicts between documents.

1.4 COMMISSIONING OBJECTIVES

.1 To support quality management through monitoring and checking of installation.

.2 To verify system performance through testing and commissioning of completed installation.

.3 To move completed facility from “static completion” state to optimal “dynamic” operating state.

.4 To transfer facility from Contractor to Departmental Representative in such a manner that provision of a quality facility has been assured.

.5 To optimize operating and maintenance through delivery of comprehensive quality training and instruction to Departmental Representative’s operating personnel.

.6 To provide accurate and useful historical records, such as, as-built drawings, test certificates, etc., to Departmental Representative.

.7 To extend commissioning into the operational phase in order to verify performance levels under a range of operating conditions; such as change of seasons.

.8 Monitor operation, performance and maintenance programs; optimize system’s performance under normal operating conditions and occupancy periods, under the direction and review of Commissioning Authority. This phase lasts throughout the warranty period. It may, however, involve activities to ensure completion of:

.9 System debugging and optimization.

.10 All commissioning activities on seasonally-sensitive systems, for varying modes and periodic simulated emergency conditions.

.11 Commissioning shall be considered complete when all of the objectives of commissioning, as specified herein, have been achieved.

1.5 COMMISSIONING MEETINGS, SCHEDULING, AND REPORTING

.1 The Contractor shall include the requirement of commissioning plan in their construction schedule and shall schedule for all tests and equipment start-up in the construction schedule.

.2 The Contractor shall attend all commissioning meetings, as called and chaired by the Commissioning Authority. The meetings shall address commissioning related responsibilities as well as all specified testing, documentation, O&M manuals, training, and post construction requirements. The testing schedules and results of all tests shall be reviewed at the meetings.

.3 The Contractor shall schedule work to include specified Commissioning related tasks, cooperate with the Departmental Representative’s Commissioning Authority, and coordinate sub trades as required, to successfully demonstrate and verify commissioning related tests.

.4 Testing forms and reports associated with the mechanical systems shall be directed to the Departmental Representative and the Commissioning Authority.

1.6 WARRANTY

.1 Involvement of the Commissioning Authority does not void any guaranties or warranties nor does it relieve the Contractor of any contractual responsibilities.

1.7 RESPONSIBILITIES OF CONTRACTOR

.1 Construction Phase:

.1 To manage and ensure the entire installation complies with the requirements of the Contract Documents.

.2 Submit shop drawings complete with Contractor's Stamp of Review.

.3 Complete commissioning data test forms.

.4 Submit a commissioning schedule. This schedule shall include:

.5 Schedule for testing and commissioning of the systems and major equipment.

.6 Time schedule for system and equipment commissioning which is in compliance with the timing and sequences of installation schedule stated above. The schedule should allow for additional time for testing and commissioning, such that re-test of the equipment can be performed in a timely manner, if required, without impacting the overall project schedule or causing delay to Project completion.

.7 Dates for completion of required factory tests prior to equipment delivery to the site shall be indicated in the schedule.

.8 Prepare and submit testing and commissioning record or report forms for review and approval.

.9 Attend commissioning meetings.

.10 Promptly rectify or replace reported deficiencies and defects.

.11 Where required by codes and/or specification, retain manufacturers and/or independent third parties to provide service for testing and certification of the systems and training of Departmental Representative's personnel.

.12 Provide training and instruction to the Departmental Representative's operating personnel.

.13 Perform testing and commissioning of equipment and systems to the satisfaction of the Departmental Representative and Commissioning Authority. Testing and commissioning will be witnessed by the Commissioning Authority as required. The Contractor or his agents shall also record procedures and findings for approved tests, which shall be submitted to the Departmental Representative and Commissioning Authority with the signature of the tester, for review and approval.

.14 Pay for and be responsible for all inspections required by codes, specification and Authorities having Jurisdiction. Obtain and submit all Certificate of Approvals for such inspections and verifications.

.15 Submit for review as-built drawings including those for location of control devices, and wiring, operating and maintenance manuals for each piece of equipment as per the specification requirements.

.16 Provide Operating and Maintenance Manuals for review by the Departmental Representative and Commissioning Authority with all the testing and commissioning results and reports incorporated.

.17 Obtain issue and assign warranties for equipment and systems to the Departmental Representative.

.18 Provision of all necessary test equipment shall be the responsibility of the contractor. Provide recently validated calibration certificates for all equipment to be used for verification prior to testing and commissioning commencement.

.2 Post-Construction Phase:

.1 Optimize operation according to occupant's needs.

.2 Complete all commissioning procedures and activities and performance verification procedures which were delayed or not concluded during the commissioning phase.

.3 Complete system checks:

.1 Once during the first month of building operation.

.2 Once during the third month of building operation.

.3 Once between the fourth and tenth months in a season opposite to the first or third month visit.

.4 Complete rectification of all deficiencies revealed by these checks. Equipment manufacturers involved in commissioning shall participate in systems checks.

.5 Revise all "as-built" and operating and maintenance documents to reflect all changes, modifications, revisions and adjustment upon completion of commissioning.

1.8 COMMISSIONING INVOLVEMENT

.1 Commissioning Authority shall direct, witness and validate as required.

1.9 SYSTEMS TO BE COMMISSIONED

.1 Mechanical systems shall include but not be limited to the following:

.1 Air Handling Unit

.2 Packaged rooftop unit

.3 Exhaust & Transfer Fans

.4 Reheat Coils

.5 Air Terminal Units

.6 Electric Force Flow Heater

.7 Hydronic and Steam Unit Heaters

.8 Heat Exchanger

.9 Humidifier

.10 Condensing Boiler

.11 Domestic Hot Water Heater

.12 Pumps

.13 Miscellaneous Ventilation System

.14 Plumbing and Drainage System

.15 Fire Protection system

.16 Building automation system.

.17 Air and water balancing

.18 Natural gas piping system

1.10 TESTING EQUIPMENT

.1 Contractor and manufacturer shall provide all instrumentation and test equipment necessary to conduct the tests specified during the commissioning process. Contractor shall submit a list of equipment to be used and copies of the latest equipment calibration certificates to the Commissioning Authority and Departmental Representative for approval.

1.11 COMMISSIONING PROCESS

.1 Commissioning Authority is to perform and complete all work as specified in this Section and elsewhere in the contract document. Contractor to follow-up during first year of operation for fine tuning and building service monitoring.

.2 Equipment verification is to be performed by the Contractor who shall test and verify proper operation of all equipment and systems prior to start of commissioning and record all results from the test for each piece of equipment. Forms shall be included in the Operating and Maintenance Manual. Equipment data shall include, but is not limited to:

.1 Manufacturer’s name, address and telephone number.

.2 Distributors’ name, address and telephone number.

.3 Make, model number and serial number.

.4 Fans - belt type and size, sheave type and size.

.5 Electrical - volts, amps, fuse size, overload size.

.6 Equipment enclosure type.

.7 Switchboard, panel board - volt, rated current, number of phase and fault rating.

.8 Any other special parameters.

1.12 TESTING FOR MECHANICAL SYSTEMS

.1 Chemical Treatment of Water:

.1 Contractor shall employ a Chemical Treatment Specialist who shall assist the Contractor with selection of the chemical treatment system, inspect the installation and test the system. The Specialist shall submit a water quality test report to the Departmental Representative and Commissioning Authority.

.2 The Specialist shall add chemical immediately after the cleaning process for protection of each system. The specialist shall test water samples and repeat the process until specification requirements are met.

.3 The Specialist shall revisit the site during first year of occupancy and re-test systems as noted in other sections of the specification.

.2 Air and Water Balancing:

.1 TAB Subcontractor shall balance the entire water system to ensure all equipment and systems are operating to design conditions. Adjust the circuits by means of the balancing valves and record the balance positions.

.2 Each pump shall be checked for design, working and shut-off head conditions. Any pump flow that varies by more than ±5% from the design conditions shall be reported to the Contractor with recommendations to resolve the issue.

.3 Flow through all heat exchangers and other such equipment shall be balanced to ensure that the pressure drop through the equipment is within ±5% of manufacturer's design conditions.

.4 Initial balancing of coils shall be used to ensure that the pressure drops are within 10% of manufacturers' design conditions. When both the air and water systems are fully operational, entering air and water and leaving air and water readings shall be taken as close as possible to the peak design conditions to ensure the coil performance meets the design conditions. Coil water working conditions shall only be taken in conjunction with the air flow working conditions for the coil.

.5 TAB Subcontractor shall co-ordinate with Contractor to ensure all necessary devices, dampers and valves for control and balancing are installed in all necessary locations so that system can be balanced to meet the requirements of the specification. Report any deficiencies noted prior to testing and failure to do so resulting in being unable to balance the systems, the cost of any changes required shall be paid for by the Contractor at no cost to Departmental Representative.

.6 TAB Subcontractor shall balance the entire air systems including air volumes and control settings under maximum system pressure drop conditions (filter at replacement condition).

.7 TAB Subcontractor shall take air measurements, make final adjustments and report upon the air volume at each variable volume box, diffuser, register and grille. Measure the static pressure upstream and downstream of the fan, the fan speed and the motor current.

.8 Measure the return and supply air flow when mixing dampers are set for full outside air and minimum outside air position.

.9 Contractor shall provide new filters after final balancing has been completed.

.10 Air volumes measured by TAB Subcontractor shall be within ±5% of those shown on Drawings for diffusers, grilles, registers, variable air volume boxes and fans, at both maximum and minimum volumes shown.

.11 Duct traverse readings shall be taken through access ports. The access ports shall be Duro Dyne IP-1 or IP-2 air tight type. Duct tape is not acceptable.

.12 In all cases where measurements by TAB Subcontractor show failure to comply with the drawings and specifications, Contractor at no cost to Departmental Representative shall change fan sheaves, etc., as required and new balancing measurements shall be taken by TAB Subcontractor.

.13 BAS Subcontractor shall make all necessary adjustments through the control system as requested by TAB Subcontractor and if failure to co-ordinate results in any cost, it should be absorbed by the Contractor with no cost to Departmental Representative.

.14 TAB Subcontractor shall repeat the balancing until required conditions are met.

.15 At time of final inspection, recheck, in presence of Departmental Representative and Commissioning Authority, random selections of data recorded in the certified report. Points or areas of recheck shall be selected by Departmental Representative/ Commissioning Authority and shall be a maximum of 30% of the report data.

.16 In the event the report is rejected, rebalance all systems, submit new certified reports and perform a re-inspection, all at no additional cost to Departmental Representative.

.17 Following final acceptance of the certified reports by Departmental Representative, permanently mark the settings of all valves and other adjustable devices so that balance set position can be restored if distributed at any time. For circuit balancing valves record the valve position by the number of turns registered on the valve and lock the valve into that position. Do not mark such devices until after final acceptance.

.18 Submit copy of air and water balancing report to the Departmental Representative and Commissioning Authority for review.

.19 Include in the Air Balancing Report:

.1 Types, serial numbers and dates of calibration of all instruments used in balancing report;

.2 Fan design and measured data: total volume flow rate, outside air flow, static pressure, motor type, RPM, volts, and full load amps;

.3 A complete system schematic with design and actual flow rates at each outlet or inlet. Show room numbers and floors. Location and number designation;

.4 Manufacturers' catalogue identification and type, of air inlets and outlets application factors, designated area, design and recorded velocities, design and recorded air flow rates.

.3 Duct Leakage Test and Pipe Pressure Test:

.1 Contractor shall test for air leakage of the in accordance with SMACNA Manuals and Standards, as noted in other sections of the specification. Test report to be forwarded to the Commissioning Authority for review and approval.

.4 Start-up and test procedures:

.1 Start-up and test procedures must be consistent with manufacturer's recommendations contained in the Operating and Maintenance Manual.

.2 The start-up report shall record all observations made during the start-up procedures including problems and their resolutions.

.3 Contractor shall retain the services of the manufacturer's technicians to test the equipment and associated systems. Technician shall record the results of the tests on the testing forms. A copy of the test forms, signed by the manufacturers' technician, shall be forwarded to the Commissioning Authority and Departmental Representative for review and comments, if any. The original copy of the test form shall be inserted into the Operating Manual.

.5 Re-Testing:

.1 Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed by the Departmental Representative and the Commissioning Authority.

.2 Tests which have not been witnessed may not be accepted and could be repeated unless directed otherwise.

.6 Air Handling Systems:

.1 Air handling units shall be inspected and tested by manufacturer's technician. Technician shall enter the test results on forms provided by manufacturer. The Departmental Representative shall witness the final operational test.

.2 Technician shall verify that the units have been installed according to manufacturer's recommendations, shop drawings and specification.

.3 Tests shall include verification of electrical power, electrical interlocks, safeties, control, heating and cooling system, fans and dampers.

.4 Technician shall start-up the air handling unit and monitor the operation for a minimum of 4 hours of running time after all tests have been completed. Technician shall issue a report to Departmental Representative and Commissioning Authority after each visit.

.5 Air handling unit manufacturer shall co-ordinate with BAS Subcontractor to provide the necessary interface to the BAS.

.6 Contractor shall rectify any deficiencies identified by TAB Subcontractor related to low/high air flow, high amperage, etc.

.7 1.23 Building Automation and Controls Systems:

.1 The Building Automation and Controls Systems shall be fully tested and commissioned by manufacturer's technician to operate in the manner defined by the specifications.

.2 BAS Subcontractor shall provide a print-out of general and critical alarm lists and all points connected to the BAS. The point-to-point verification report for all control and monitoring points shall be submitted to the Commissioning Authority prior to the acceptance test.

.3 BAS Subcontractor shall provide an operating terminal and sufficient training and instruction to TAB Contractor which will allow them to set-up and balance the water and air systems.

.4 All sensors to be calibrated to ensure the recorded data are accurate.

.5 Ensure all required interfaces are properly installed such as interface with life safety monitoring system.

.6 BAS Subcontractor in conjunction with the mechanical contractor shall create simulated design load conditions for control verification tests.

.7 Testing procedures should include but not limited to:

.8 Check and verify that each input point is reporting to the Building Automation and Controls Systems panels and workstations in the normal state and change or state.

.9 Create false alarms at each point and provide a print-out of the test.

.10 Command each output point, via workstation and verify action at the device.

.11 Verify that each time of day and optimum start program is operational in software and at the device.

.12 Verify that each program is operational in software and at the device(s).

.13 Verify that each system graphic is dynamically updating.

.14 Test each DDC loop and verify that it is controlling in a stable manner. Create set point changes on output points. False loads shall be introduced to observe the control loops response.

.15 Verify that each report type is functional.

.16 Verify that each global program that controls more than 1 system is operating.

.17 Verify that all safeties are operating (i.e. fire stat).

.18 Verify valve and damper actuation.

.19 Verify the calibration of each analog input point.

.20 Any sensor disconnected from the input terminal after completion of the performance test shall be retested.

.21 BAS Subcontractor shall provide a "signed-off" copy of the results of all tests to the Commissioning Authority/Departmental Representative. Acceptance test will not begin until the tests have been reviewed and accepted.

.22 When all tests have been completed by BAS Subcontractor, the acceptance test procedure shall begin as noted in other sections of this specification.

.23 During the acceptance test Contractor shall log all-points in each day. The logs shall be issued to Commissioning Authority for review.

.24 System shall not be accepted or considered substantially complete until all tests are completed and approved.

.25 BAS Subcontractor shall provide a minimum of 2 weeks' notice to the Commissioning Authority prior to testing date.

.26 BAS Subcontractor shall revisit the site during the first year of operation to review the performance of the Building Automation and Controls Systems. The review shall include DDC loop tuning, sensor calibration, programs, communication, DDC panels, workstations and the operational logs.. The visits shall be:

.1 Beginning of cooling season

.2 During the cooling season

.3 Beginning of heating season

.4 During the heating season

1.13 OPERATING AND MAINTENANCE MANUAL

.1 Contractor shall prepare and submit the Operating and Maintenance Manual in accordance with Section 01 78 00 – Closeout Submittals to Departmental Representative/ Commissioning Authority prior to beginning of training.

.2 The final copy of the O&M manual shall be submitted to the Departmental Representative after all comments provided by the Commissioning Authority and Departmental Representative are addressed by the Contractor.

1.14 OPERATOR TRAINING AND INSTRUCTIONS

.1 Contractor and equipment manufacturers shall provide operator training for each mechanical system and equipment. The training shall meet all requirements as noted in other sections of this specification.

.2 Each session shall be structured to cover:

- .1 The Operating and Maintenance Manual.
- .2 Operating procedures.
- .3 Maintenance procedures.
- .4 Trouble-shooting procedures.
- .5 Manufacturer's or service representative's name, address and phone number.

.3 Contractor shall prepare a detailed training and instruction plan. This plan shall include the outline of all sessions and identification of the training presenters.

.4 Training and instruction requirement for the mechanical system shall include a walk-through of building by Contractor.

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 is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.

.2 Acronyms:

.1 BMM - Building Management Manual.

.2 Cx - Commissioning.

.3 HVAC - Heating, Ventilation and Air Conditioning.

.4 PI - Product Information.

.5 PV - Performance Verification.

.6 TAB - Testing, Adjusting and Balancing.

.7 WHMIS - Workplace Hazardous Materials Information System.

1.2 GENERAL REQUIREMENTS

.1 Standard letter size paper 216 mm x 279 mm.

.2 Methodology used to facilitate updating.

.3 Drawings, diagrams and schematics to be professionally developed.

.4 Electronic copy of data to be in a format accepted and approved by Departmental Representative.

1.3 APPROVALS

.1 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

1.4 GENERAL INFORMATION

.1 Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:

.1 Complete list of names, addresses, telephone and fax numbers of Contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.

.2 Summary of architectural, structural, fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.

.1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.

.3 Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.

.4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.

.5 Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.

.6 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.

.7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.

.8 Operating and maintenance manual - Section 3.2 of BMM.

.9 Final commissioning plan as actually implemented.

.10 Completed commissioning checklists.

.11 Commissioning test procedures employed.

.12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.

.13 Commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

.1 For detailed requirements refer to Section 01 78 00 – Closeout Submittals.

.2 Departmental Representative to review and approve format and organization within twelve (12) weeks of award of contract.

.3 Include original manufactures brochures and written information on products and equipment installed on this project.

.4 Record and organize for easy access and retrieval of information contained in BMM.

.5 Include completed PI report forms, data and information from other sources as required.

.6 Inventory directory relating to information on installed systems, equipment and components.

.7 Approved project shop-drawings, product and maintenance data.

.8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.

.9 Inventory and location of spare parts, special tools and maintenance materials.

.10 Warranty information.

.11 Inspection certificates with expiration dates, which require on-going re-certification inspections.

.12 Maintenance program supporting information including:

.1 Recommended maintenance procedures and schedule.

.2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

1.6 LIFE SAFETY COMPLIANCE (LSC) MANUAL

.1 Samples of LSC Manual will be available from Departmental Representative.

.2 Content of Manual:

.1 All possible Emergency situations modes including: presence of fire and smoke, power failure, lose of water or pressure, chemical spills and refrigerant release.

.2 Failure of elevators and escalators.

.3 HVAC emergencies and fuel supply failures.

.4 Intrusion and security breach.

.5 Emergency provisions for natural disasters, bomb threats and other disruptive situations.

.6 Dedicated emergency generators for high security projects, medical facilities and computer systems.

.7 Emergency control procedures for fire, power and major equipment failure.

.8 Emergency contacts and numbers.

.9 Manual to be readily available and comprehensible to non-technical readers.

1.7 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

.1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:

.1 General:

.2 Finalized commissioning plan.

.3 WHMIS information manual.

.4 Approved "as-built" drawings and specifications.

.5 Procedures used during commissioning.

.6 Cross-Reference to specification sections.

.2 Architectural and structural:

.1 Inspection certificates, construction permits.

.2 Roof anchor log books.

.3 PV reports.

.3 Fire prevention, suppression and protection:

.1 Test reports.

.2 Smoke test reports.

.3 PV reports.

.4 Mechanical:

.1 Installation permits, inspection certificates.

.2 Piping pressure test certificates.

.3 Ducting leakage test reports.

.4 TAB and PV reports.

.5 Charts of valves and steam traps.

.6 Copies of posted instructions.

.5 Electrical:

.1 Installation permits, inspection certificates.

.2 TAB and PV reports.

.3 Electrical work log book.

.4 Charts and schedules.

.5 Locations of cables and components.

.6 Copies of posted instructions.

.6 Assist Departmental Representative with preparation of BMM.

1.8 LANGUAGE

.1 English and French Language to be in separate binders.

1.9 USE OF CURRENT TECHNOLOGY

.1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.

.2 Obtain Departmental Representative's approval before starting Work.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 82 00.01 – Asbestos Abatement Minimum Precautions.

.2 Section 02 82 00.02 – Asbestos Abatement Intermediate Precautions

.3 Section 02 82 00.03 – Asbestos Abatement Maximum Precautions

.4 Section 02 83 11 – Lead - Base Paint Abatement Intermediate Precautions

.5 Section 02 83 12 – Lead - Base Paint Abatement Maxiumum Precautions

1.2 REFERENCES

.1 Definitions:

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

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

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

.2 Reference Standards:

.1 Canadian Environmental Protection Act,1999 (CEPA 1999)

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Department of Justice Canada (Jus)

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

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

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

.1 Material Safety Data Sheets (MSDS).

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

.1 National Fire Code of Canada-2010.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29 to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.

.3 Submit hazardous materials management plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 When hazardous waste is generated on site:

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

.2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.3 Use licensed carrier authorized by provincial authorities to accept subject material.

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

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

.6 Only trained personnel handle, offer for transport, or transport dangerous goods.

.7 Provide photocopy of shipping documents and waste manifests to Departmental Representative.

.8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide photocopy of completed manifest to Departmental Representative.

.9 Report discharge, emission, or escape of hazardous materials immediately to Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

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

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

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities hazardous material required to perform Work.

.2 Provide all temporary facilities, equipment, containers and spill remediation kits required by Authority Having Jurisdiction and as necessary to complete the work of this Section.

.3 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 EXECUTION

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

.9 Sequence abatement and removal of Hazardous Materials with demolition work; complete removal of Hazardous Materials and make areas clean before actual start of demolition activities.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following work:

.1 Removing non-friable asbestos-containing materials, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

.2 Break, cut, grind, sand, drill, scrape, vibrate or abrade non-friable asbestos containing materials using non-powered hand-held tools, and the material is wetted to control the spread of dust or fibres.

1.2 SECTION INCLUDES

.1 Comply with requirements and procedures for asbestos abatement of the following asbestos-containing materials where noted on drawings or affected by the work:

.1 Transite fumehoods, associated millwork with transite within and exhaust ductwork in Labs L527/L530 of the A&L Building.

.2 Bakelite countertops and vinyl floor tiles in Labs L527/L530 of the A&L Building.

.3 White caulking at door frames and joints of concrete block walls in Labs L527/L530 and 5th Floor Offices of the A&L Building.

.4 Presumed asbestos-containing roofing at Air Handling Units (AHU) 43, 44 and the abandoned AHU in the Mezzanine to facilitate the removal of the existing AHUs and installation of the new AHUs and any other items including but not limited to ductwork, penetrations, etc. through the roof of the Hydraulics Building.

.5 Mastic at the joints and within the abandoned AHU in the Mezzanine Mechanical Room of the Hydraulics Building.

.6 Mastic at joints and within AHUs 1, 3 and 5 in the R&D Penthouse.

.7 Presumed asbestos-containing roofing from the A&L and R&D Buildings to facilitate any work.

.8 Presumed asbestos-containing roofing from the WTC Building to facilitate the construction of the new Penthouse.

.9 Vinyl floor tiles and caulking at door frames and joints of concrete block wall in fifth floor offices and adjacent corridor of the A&L Building.

.10 Transite fumehoods exhaust ducting within the A&L Building.

.11 Redundant metal exhaust ductwork with asbestos-containing mastic present above the ceiling tiles in Lab L435 of the A&L Building.

1.3 REFERENCES

.1 Department of Justice Canada (JUS)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.2 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.3 O. Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.

.4 O. Reg. 490/09, Designated Substances.

.5 A Guide to the Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, http://www.labour.gov.on.ca/english/hs/ asbestos/index.html.

1.4 DEFINITIONS

.1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Amended Water: water with nonionic surfactant wetting agent added to reduce water tension to allow thorough wetting of fibres.

.3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.

.5 Authorized Visitors: Engineers, Consultants or designated representatives, and representatives of regulatory agencies.

.6 Competent worker person: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the work.

.2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.7 Friable material: means material that:

.1 When dry, can be crumbled, pulverized or powdered by hand pressure, or

.2 is crumbled, pulverized or powdered.

.8 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.9 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.

.10 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

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

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

.4 Submit proof of Contractor's Asbestos Liability Insurance.

.5 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.6 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.7 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.6 QUALITY ASSURANCE

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

.2 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Section 01 35 29.

.2 Safety Requirements: worker protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable-type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are to be provided by the contractor.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 and plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal banding, flatten and place in designated area for recycling.

.8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.

.9 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

.1 Refer to Appendix A, Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 10, 2015 and Appendix B, Final Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 15, 2015.

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

1.9 SCHEDULING

.1 Coordinate schedule with Departmental Representative.

1.10 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, following minimum requirements:

.1 Fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Instruction and training must be provided by a competent, qualified person.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Drop Sheets:

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of asbestos-containing material.

.3 Waste Containers: contain waste in two separate containers.

.1 Inner container: 0.15 mm thick sealable polyethylene waste bag.

.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.

.3 Labelling requirements: affix pre-printed cautionary asbestos warning in both official languages that is visible when ready for removal to disposal site.

.4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.5 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

Part 3 EXECUTION

3.1 PROCEDURES

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Before beginning Work, isolate Asbestos Work Area using, minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area.

.1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.

.2 Use HEPA vacuum or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.

.3 Do not use compressed air to clean up or remove dust from any surface.

.3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in Asbestos Work Area where dust and contamination cannot otherwise be safely contained. Drop sheets are not to be reused.

.4 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.

.1 Use garden reservoir type low - velocity fine - mist sprayer.

.2 Perform Work to reduce dust creation to lowest levels practicable.

.3 Work will be subject to visual inspection and air monitoring.

.4 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.5 Frequently and at regular intervals during Work and immediately on completion of work:

.1 Dust and waste to be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a waste container, and

.2 Drop sheets to be wetted and placed in a waste container as soon as practicable.

.6 Cleanup:

.1 Place dust and asbestos containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, and then place in plastic bags.

.2 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.

.3 Seal waste bags and remove from site. Dispose of in accordance with requirements of Provincial and Federal Authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that the appropriate guidelines and regulations for asbestos disposal are followed.

.4 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Removal or disturbance of one square metre or less of friable asbestos containing material during the repair, alteration, maintenance or demolition of all or part of machinery or equipment, or of a building.

1.2 SECTION INCLUDES

.1 Requirements and procedures for asbestos abatement of the following asbestos-containing materials where noted on drawings or affected by the work:

.1 Parging cement pipe fitting in Lab H158 of the Hydraulics Building.

.2 Parging cement pipe fittings in the R&D Penthouse at Air Handling Units (AHU) 3 and 5.

.3 Parging cement pipe fittings in the Second Floor of WTC Building.

.4 Doors (fire doors) scheduled for demolition where asbestos insulation may be present within.

.5 Asbestos pipe insulation within the service corridors of the A&L Building.

1.3 REFERENCES

.1 O.Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.

.2 A Guide to the Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, http://www.labour.gov.on.ca/english/hs/ asbestos/index.html.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-94, Sealer for Application of Asbestos Fibre Releasing Materials.

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

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

.1 Material Safety Data Sheets (MSDS).

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.7 Underwriters' Laboratories of Canada (ULC).

1.4 DEFINITIONS

.1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.2 Asbestos Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.

.4 Authorized Visitors: Engineers, or designated representatives, and representatives of regulatory agencies.

.5 Competent worker person: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the work.

.2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.6 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

.7 Glove Bag: prefabricated glove bag as follows:

.1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.

.2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.

.3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.

.4 Straps for sealing ends around pipe.

.8 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

.9 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.10 Occupied Area: any area of building or work site that is outside Asbestos Work Area.

.11 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.12 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

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

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

.4 Submit proof of Contractor's Asbestos Liability Insurance.

.5 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.

.6 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.7 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.8 Submit Worker's Compensation Board status and transcription of insurance.

.9 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:

.1 Encapsulants;

.2 Amended water;

.3 Slow drying sealer.

.10 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.6 QUALITY ASSURANCE

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

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.

.3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are to be provided by the contractor.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.7 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

.2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal banding, flatten and place in designated area for recycling.

.8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial/Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.

.9 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

.1 Refer to Appendix A, Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 10, 2015 and Appendix B, Final Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 15, 2015.

.2 Notify Departmental Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 SCHEDULING

.1 Coordinate schedule with Departmental Representative.

1.10 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, at minimum:

.1 Fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Instruction and training must be provided by competent, qualified person.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Drop and Enclosure Sheets:

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.

.3 Waste Containers: contain waste in two separate containers.

.1 Inner container: 0.15 mm thick sealable polyethylene bag.

.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.

.3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.

.4 Glove bag:

.1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during bid period in accordance with Instructions to Bidders.

.2 The glove bag to be equipped with:

.1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.

.2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure.

.3 A tool pouch with a drain.

.4 A seamless bottom and a means of sealing off the lower portion of the bag.

.5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

.5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

.6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 50 and be compatible with new fireproofing

.7 Encapsulant: surface film forming or penetrating type conforming to CAN/CGSB-1.205 ULC listed.

Part 3 EXECUTION

3.1 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

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

.3 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.

.1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.

.2 Do not use compressed air to clean up or remove dust from any surface.

.4 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.

.2 When removing suspended ceilings and walls themselves do not enclose work area and when removing asbestos containing material from piping or equipment and "glove bag" method is not used] erect enclosure of polyethylene sheeting around work area, shut off mechanical ventilation system serving work area and seal ventilation ducts to and from work area.

.5 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.

.1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.

.2 Perform Work in a manner to reduce dust creation to lowest levels practicable.

.6 Pipe Insulation Removal Using Glove Bag:

.1 A glove bag not to be used to remove insulation from a pipe, duct or similar structure if:

.1 It may not be possible to maintain a proper seal for any reason including, without limitation:

.1 The condition of the insulation.

.2 The temperature of the pipe, duct or similar structure.

.2 The bag could become damaged for any reason including, without limitation.

.1 The type of jacketing.

.2 The temperature of the pipe, duct or similar structure.

.2 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be reused.

.3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.

.4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.

.5 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.

.6 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.

.7 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.

.8 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.

.7 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.8 Cleanup:

.1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.

.2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.

.3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

.4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.

.5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples on daily basis outside of Asbestos Work Area enclosures in accordance with Provincial Occupational Health and Safety Regulations and PWGSC requirements.

.1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations.

.2 If air monitoring shows that areas outside Asbestos Work Area enclosures are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.

.3 Ensure that respiratory safety factors are not exceeded.

.4 During the course of Work, Departmental Representative to measure fibre content of air outside Work areas by means of air samples analyzed by Phase Contrast Microscopy (PCM).

.1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Removal or disturbance as specified of more than one square metre of friable asbestos containing material during the repair, alteration, maintenance or demolition of a building or any machinery or equipment located as indicated.

1.2 SECTION INCLUDES

.1 Requirements and procedures for asbestos abatement of the following asbestos-containing materials where noted on drawings or affected by the work:

.1 Ductwork insulation and parging cement pipe fittings from and around Air Handling Unit (AHU) 43 in the Hydraulics Building.

.2 Parging cement pipe fittings to facilitate the removal of the abandoned AHU and facilitate the installation of AHU 43 in the Mezzanine Mechanical Room of the Hydraulics Building.

.3 Ductwork insulation and parging cement pipe insulation from and around AHU 1 in the R&D Building. Seal exposed end ends insulation to remain with canvas and lagging.

.4 Parging cement pipe fittings from pipes scheduled for demolition in the tunnel from WTC to A&L Buildings, pipe chases and areas noted on the drawings.

.5 All asbestos-containing materials in the Penthouse of the WTC Building, including: ductwork insulation, hot water tank insulation and parging cement pipe fittings.

1.3 REFERENCES

.1 O.Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.

.2 A Guide to the Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, http://www.labour.gov.on.ca/english/hs/ asbestos/index.html.

.3 Public Works and Government Services Canada.

.1 Annex C - Appendix 6 - Work Procedures of PWGSC DM Directive 057 Asbestos Management.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-94, Sealer for Application to Asbestos-Fibre-Releasing Materials.

.5 Canadian Standards Association (CSA International).

.6 Department of Justice Canada

.1 Canadian Environmental Protection Act (CEPA), 1999.

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

.1 Material Safety Data Sheets (MSDS).

.8 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.9 Underwriters' Laboratories of Canada (ULC).

.10 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH)

.1 NIOSH 94-113-August 1994, NIOSH Manual of Analytical Methods (NMAM), 4th Edition.

.11 U.S. Department of Labour - Occupational Safety and Health Administration - Toxic and Hazardous Substances

.1 29 CFR 1910.1001-2001, Asbestos Regulations.

1.4 DEFINITIONS

.1 Airlock: system for permitting ingress or egress without permitting air movement between contaminated area and uncontaminated area, typically consisting of two curtained doorways at least 2 m apart.

.2 Amended Water: water with a non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.3 Asbestos Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.4 Asbestos Work Areas: area where work takes place which will, or may disturb ACMs.

.5 Authorized Visitors: Departmental Representatives or designated representatives, and representatives of regulatory agencies.

.6 Competent worker person: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the work.

.2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.7 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:

.1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.

.2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.

.3 Overlap each polyethylene sheet at openings not less than 1.5 m on each side.

.8 DOP Test: testing method used to determine integrity of Negative Pressure unit using dioctyl phthalate (DOP) HEPA-filter leak test.

.9 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

.10 Glove Bag: prefabricated glove bag as follows:

.1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.

.2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.

.3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.

.4 Straps for sealing ends around pipe.

.11 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.12 Negative pressure: system that extracts air directly from work area, filters such extracted air through High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building.

.1 System to maintain minimum pressure differential of 5 Pa relative to adjacent areas outside of work areas, be equipped with alarm to warn of system breakdown, and be equipped with instrument to continuously monitor and automatically record pressure differences.

.13 Non-Friable Materials: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.14 Occupied Areas: any area of building or work site that is outside Asbestos Work Area.

.15 Polyethylene sheeting sealed with tape: polyethylene sheeting of type and thickness specified sealed with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealants, and to prevent escape of asbestos fibres through sheeting into clean area.

.16 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Before beginning work:

.1 Obtain from appropriate agency and submit to Departmental Representative necessary permits for transportation and disposal of asbestos waste. Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal. Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to receive and properly dispose of asbestos waste.

.2 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person on hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Submit proof of attendance in form of certificate.

.3 Ensure supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers.

.4 Submit layout of proposed enclosures and decontamination facilities to Departmental Representative for review.

.5 Submit Provincial/Territorial and/or local requirements for Notice of Project form.

.6 Submit proof of Contractor's Asbestos Liability Insurance.

.7 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

.8 Submit Workplace Safety and Insurance Board status and transcription of insurance.

.9 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including but not limited to following:

.1 Encapsulants.

.2 Amended water.

.3 Slow drying sealer.

1.6 QUALITY ASSURANCE

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

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area includes:

.1 Powered air purifying respirator (PAPR) with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn. Requirements for each worker:

.1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters that have been tested as satisfactory, clean coveralls and head covers before entering Equipment and Access Rooms or Asbestos Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.

.2 Remove gross contamination from clothing before leaving work area then proceed to Equipment and Access Room and remove clothing except respirators. Place contaminated work suits in receptacles for disposal with other asbestos - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. Still wearing the respirator proceed naked to showers. Using soap and water wash body and hair thoroughly. Clean outside of respirator with soap and water while showering; remove respirator; remove filters and wet them and dispose of filters in container provided for purpose; and wash and rinse inside of respirator. When not in use in work area, store work footwear in Equipment and Access Room. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from work area or from Equipment and Access Room.

.3 After showering and drying off, proceed to clean change room and dress in street clothes at end of each day's work, or in clean coveralls before eating, smoking, or drinking. If re-entering work area, follow procedures outlined in paragraphs above.

.4 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers must not use this system as means to leave or enter work area.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual asbestos abatement.

.4 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.

.5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.6 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

.2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal banding, flatten and place in designated area for recycling.

.8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.152 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.

.9 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

.1 Refer to Appendix A, Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 10, 2015 and Appendix B, Final Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 15, 2015. These are for general information only and are not necessarily representative of asbestos containing materials covered within scope of this Project.

.2 Notify Departmental Representative of suspect asbestos containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 SCHEDULING

.1 Not later than ten (10) days before beginning Work on this Project notify following in writing:

- .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
- .2 Regional Office of Labour Canada.
- .3 Provincial/Territorial, Department of Labour.
- .4 Disposal Authority.

.2 Inform sub-trades of presence of asbestos containing materials identified in Existing Conditions.

.3 Submit to Departmental Representative copy of notifications prior to start of Work.

.4 Coordinate schedule with Departmental Representative.

1.10 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide to Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene including dress and showers, in entry and exit from Asbestos Work Area, in aspects of work procedures including glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, at minimum:

.1 Proper fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Instruction and training must be provided by competent, qualified person.

.4 Supervisory personnel to complete required training.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Polyethylene: minimum 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.

.2 FR polyethylene: minimum 0.15 mm thick, woven fibre reinforced fabric bonded both sides with polyethylene.

.3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

.4 Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether, or other material approved by Departmental Representative, mixed with water in concentration to provide adequate penetration and wetting of asbestos containing material.

.5 Waste Containers: contain waste in two separate containers.

.1 Inner container: 0.15 mm thick sealable polyethylene bag or where glove bag method is used, glove bag itself.

.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.

.3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site. Label containers in accordance with Asbestos Regulations 29 CFR 1910.1001. Label in both official languages.

.6 Glove bag:

.1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during tendering period in accordance with Instructions to Tenderers.

.2 The glove bag to be equipped with:

.1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.

.2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure.

.3 A tool pouch with a drain.

.4 A seamless bottom and a means of sealing off the lower portion of the bag.

.5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

.7 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

.8 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.9 Sealer: flame spread and smoke developed rating less than 50 and be compatible with new fireproofing.

.10 Encapsulants: surface film forming or penetrating type conforming to CAN/CGSB-1.205 ULC listed.

Part 3 EXECUTION

3.1 PREPARATION

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Work Areas:

.1 Shut off and isolate air handling and ventilation systems to prevent fibre dispersal to other building areas during work phase. Conduct smoke tests to ensure that duct work is airtight. Seal and caulk joints and seams of active return air ducts within Asbestos Work Area.

.2 Preclean moveable furniture and flooring within proposed work areas using HEPA vacuum and remove from work areas to temporary location acceptable to the Departmental Representative.

.3 Preclean fixed casework, plant, and equipment within proposed work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.

.4 Clean proposed work areas using, where practicable, HEPA vacuum cleaning equipment. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum equipment.

.5 The spread of dust from the work area to be prevented by:

.1 Using enclosures of polyethylene or other suitable material that is impervious to asbestos (including, if the enclosure material is opaque, one or more transparent window areas to allow observation of the entire work area from outside the enclosure), if the work area is not enclosed by walls.

.2 Using curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted on each side of each entrance or exit from the work area.

.6 Put negative pressure system in operation and operate continuously from time first polyethylene is installed to seal openings until final completion of work including final cleanup. Provide continuous monitoring of pressure difference using automatic recording instrument. The system to maintain a negative air pressure of 5 Pa (0.02 inches) of water, relative to the area outside the enclosed area. The system to be inspected and maintained by a competent person prior each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it to be replaced before the ventilation system is used.

.7 Seal off openings such as corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.

.8 Cover floor and wall surfaces with polyethylene sheeting sealed with tape. Two layers of FR polyethylene on floors. Cover floors first so that polyethylene extends at least 300 mm up walls then cover walls to overlap floor sheeting.

.9 Build airlocks at entrances to and exits from work areas so that work areas are always closed off by one curtained doorway when workers enter or exit.

.10 At each access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used: "CAUTION ASBESTOS HAZARD AREA (25 mm) NO UNAUTHORIZED ENTRY (19 mm) WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)".

.11 After work area isolation, remove heating, ventilating, and air conditioning filters, pack in sealed plastic bags 0.15 mm minimum thick and treat as contaminated asbestos waste. Remove ceiling - mounted objects such as lights, partitions, other fixtures not previously sealed off, and other objects that interfere with asbestos removal, as directed by Departmental Representative. Use localized water spraying during fixture removal to reduce fibre dispersal.

.12 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Fire Commissioner of Canada and Provincial/Territorial Fire Marshall Authority having jurisdiction.

.13 Where application of water is required for wetting asbestos containing materials, shut off electrical power, provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.

.14 After preparation of work areas and Decontamination Enclosure Systems, for the removal of all other asbestos containing materials, remove within work area and dispose of as contaminated waste in specified containers. Spray asbestos debris and immediate work area with amended water to reduce dust, as work progresses.

.3 Worker Decontamination Enclosure System:

.1 Worker Decontamination Enclosure System includes Equipment and Access Room, Shower Room, and Clean Room, as follows:

.1 Equipment and Access Room: build Equipment and Access Room between Shower Room and work areas, with two curtained doorways, one to Shower Room and one to work areas. Install portable toilet, waste receptor, and storage facilities for workers' shoes and protective clothing to be reworn in work areas. Build Equipment and Access Room large enough to accommodate specified facilities, other equipment needed, and at least one worker allowing him /her sufficient space to undress comfortably.

.2 Shower Room: build Shower Room between Clean Room and Equipment and Access Room, with two curtained doorways, one to Clean Room and one to Equipment and Access Room. Provide one shower for every five workers. Provide constant supply of hot and cold or warm water. Water source and drains to common sewer are the responsibility of the Contractor. Provide piping and connect to water sources and drains. Pump waste water through 5 micrometre filter system acceptable to Departmental Representative before directing into drains. Provide soap, clean towels, and appropriate containers for disposal of used respirator filters.

.3 Clean Room: build Clean Room between Shower Room and clean areas outside of enclosures, with two curtained doorways, one to outside of enclosures and one to Shower Room. Provide lockers or hangers and hooks 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.

.4 Container and Equipment Decontamination Enclosure System:

.1 Container and Equipment Decontamination Enclosure System consists of Staging Area within work area, Washroom, Holding Room, and Unloading Room. Purpose of system is to provide means to decontaminate waste containers, scaffolding, waste and material containers, vacuum and spray equipment, and other tools and equipment for which Worker Decontamination Enclosure System is not suitable.

.1 Staging Area: designate Staging Area in work area for gross removal of dust and debris from waste containers and equipment, labelling and sealing of waste containers, and temporary storage pending removal to Washroom. Equip Staging Area with curtained doorway to Washroom.

.2 Washroom: build Washroom between Staging Area and Holding Room with two curtained doorways, one to Staging Area and one to Holding Room. Provide high - pressure low - volume sprays for washing of waste containers and equipment. Pump waste water through 5 micrometre filter system before directing into drains. Provide piping and connect to water sources and drains.

.3 Holding Room: build Holding Room between Washroom and Unloading Room, with two curtained doorways, one to Washroom and one to Unloading Room. Build Holding Room sized to accommodate at least two waste containers and largest item of equipment used.

.4 Unloading Room: build Unloading Room between Holding Room and outside, with two curtained doorways, one to Holding Room and one to outside.

.5 Construction of Decontamination Enclosures:

.1 Build suitable framing for enclosures and line with polyethylene sheeting sealed with tape. Use two layers of FR polyethylene on floors, walls and ceiling.

.2 Build curtained doorways between enclosures so that when people move through or when waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.

.6 Separation of Work Areas from Occupied Areas:

.1 Separate parts of building required to remain in usefrom parts of building used for asbestos abatement by means of airtight barrier system constructed as follows:

.1 Build suitable floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood. Seal joints between plywood sheets and between plywood and adjacent materials with surface film forming type sealer, to create airtight barrier.

.2 Cover plywood barrier with polyethylene sealed with tape, as specified for work areas.

.7 Maintenance of Enclosures:

.1 Maintain enclosures in tidy condition.

.2 Ensure that barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

.3 Visually inspect enclosures at beginning of each working period.

.4 Use smoke methods to test effectiveness of barriers when directed by Departmental Representative.

.8 Do not begin Asbestos Abatement work until:

.1 Arrangements have been made for disposal of waste.

.2 For wet stripping techniques, arrangements have been made for containing, filtering, and disposal of waste water.

.3 Work areas and decontamination enclosures and parts of building required to remain in use are effectively segregated.

.4 Tools, equipment, and materials waste containers are on hand.

.5 Arrangements have been made for building security.

.6 Warning signs are displayed where access to contaminated areas is possible.

.7 Notifications have been completed and other preparatory steps have been taken.

3.2 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos containing materials.

3.3 ASBESTOS REMOVAL

.1 Before removing asbestos:

.1 Prepare site.

.2 Spray asbestos material with water containing specified wetting agent, using airless spray equipment capable of providing "mist" application to prevent release of fibres. Saturate asbestos material sufficiently to wet it to substrate without causing excess dripping. Spray asbestos material repeatedly during work process to maintain saturation and to minimize asbestos fibre dispersion.

.2 .2 Remove saturated asbestos material in small sections. Do not allow saturated asbestos to dry out. As it is being removed pack material in sealable plastic bags 0.15 mm minimum thick and place in labelled containers for transport.

.3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure that containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.

.4 After completion of stripping work, wire brushed and wet sponged surfaces from which asbestos has been removed to remove visible material. During this work keep surfaces wet.

.5 Where Departmental Representative decides complete removal of asbestos containing material is impossible due to obstructions such as structural members or major service elements, or because asbestos containing material was originally applied to asphaltic coating, and provides written direction, encapsulate material as follows:

.1 Apply surface film forming type sealer to provide 0.635 mm minimum dry film thickness over sprayed asbestos surfaces. Apply using airless spray equipment to avoid blowing off fibres. Use different colour for each coat. Use red colour for final coat. Apply penetrating type sealer to penetrate existing sprayed asbestos surfaces to uniform depth of 25 mm minimum. Apply penetrating type sealer to penetrate existing sprayed asbestos surfaces uniformly to substrate.

.6 After wire brushing and wet sponging to remove visible asbestos, wet clean entire work area including Equipment and Access Room, and equipment used in process. After 24 hour period to allow for dust settling, wet clean these areas and objects again. During this settling period no entry, activity, or ventilation will be permitted. After second 24 hour period under same conditions, clean these areas and objects again using HEPA vacuum followed by wet cleaning. After inspection by Departmental Representative apply continuous coat of slow drying sealer to surfaces of work area. Allow at least 16 hours with no entry, activity, ventilation, or disturbance other than operation of negative pressure units during this period.

.7 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.8 Cleanup:

.1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.

.2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.

.3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

.4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.

.5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.4 FINAL CLEANUP

.1 Following cleaning specified above, and when air sampling shows that asbestos levels on both sides of seals do not exceed 0.01 fibres/cc as determined by membrane filter method at 400-500X magnification phase contrast illumination, as described in NIOSH Method 94-113 or equivalent, proceed with final cleanup.

.2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible asbestos containing particles observed during cleanup, immediately, using HEPA vacuum equipment.

.3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.

.4 Include in clean-up Work areas, Equipment and Access Room, Washroom, Shower Room, and other contaminated enclosures.

.5 Include in clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.

.6 Conduct final check to ensure that no dust or debris remains on surfaces as result of dismantling operations and carry out air monitoring again to ensure that asbestos levels in building do not exceed 0.01 fibres/cc. Repeat cleaning using HEPA vacuum equipment, or wet cleaning methods where feasible, in conjunction with sampling until levels meet this criteria.

.7 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled containers containing asbestos waste and dispose of to authorized disposal area in accordance with requirements of disposal authority. Ensure that each shipment of containers transported to dump is accompanied by Contractor's representative to ensure that dumping is done in accordance with governing regulations.

3.5 RE-ESTABLISH- MENT OF OBJECTS AND SYSTEMS

.1 When cleanup is complete:

.1 Re-establish objects and furniture moved to temporary locations in course of Work, in their proper positions.

.2 Re-secure mounted objects removed in course of Work in their former positions.

.3 Re-establish mechanical and electrical systems in proper working order. Install new filters.

.4 Repair or replace objects damaged in the course of Work, as directed by Departmental Representative.

3.6 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples on daily basis outside of work area enclosure in accordance with Health Canada recommendations.

.1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.

.2 Use results of air monitoring inside work area to establish type of respirators to be used. Workers may be required to wear sample pumps for up to full-shift periods.

.1 If fibre levels are above safety factor of respirators in use, stop abatement, apply means of dust suppression, and use higher safety factor in respiratory protection for persons inside enclosure.

.2 If air monitoring shows that areas outside work area enclosures are contaminated, enclose, maintain and clean these areas, in same manner as that applicable to work areas.

.3 During course of Work, Departmental Representative to measure fibre content of air outside work areas by means air samples analyzed by Phase Contrast Microscopy (PCM).

.1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.

.4 Final air monitoring to be conducted as follows: After Asbestos Work Area has passed visual inspection and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period has passed, Departmental Representative will perform air monitoring within Asbestos Work Area by aggressive methods, where provincial regulations require.

.1 Final air monitoring results must show fibre levels of less than 0.01 f/cc.

.2 If air monitoring results show fibre levels in excess of 0.01 f/cc, re-clean work area and apply another acceptable coat of lock-down agent to surfaces.

.3 Repeat as necessary until fibre levels are less than 0.01 f/cc.

3.7 INSPECTION

.1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviations from these requirements that have not been approved in writing by Departmental Representative may result in Work stoppage, at no cost to Owner.

.2 Departmental Representative will inspect Work for:

.1 Adherence to specific procedures and materials.

.2 Final cleanliness and completion.

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

.3 When asbestos leakage from Asbestos Work Area has occurred or is likely to occur Departmental Representative may order Work shutdown.

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

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing the following Work:

.1 Removal of flaking/peeling lead based paint from the Air Handling Units (AHUs) 1 and 3 in the R&D Mechanical Penthouse by scraping or sanding using non-powered hand tools.

.2 Removal of lead-containing coatings or materials using a power tool with an effective dust collection system equipped with a HEPA filter from surfaces that will be disturbed by the work.

1.2 SECTION INCLUDES

.1 Requirements and procedures for abatement of lead based paints.

1.3 REFERENCES

.1 Ontario Ministry of Labour

.1 Occupational Health and Safety Branch, Guideline Lead On Construction Projects, September 2004, O. Reg. 490/09 respecting Designated Substances - Lead made under the Occupational Health and Safety Act as amended by O. Reg. 148/12 and O. Reg. 149/12.

.2 Department of Justice Canada

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada

.1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).

.4 Human Resources and Social Development Canada (HRSDC)

.1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.

.5 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.6 U.S. Environmental Protection Agency (EPA)

.1 EPA 747-R-95-007-1995, Sampling House Dust for Lead.

.7 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)

.1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).

.8 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances

.1 Lead in Construction Regulation - 29 CFR 1926.62-1993.

.9 Underwriters' Laboratories of Canada (ULC)

.1 Report of the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario, 1984.

1.4 DEFINITIONS

.1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Authorized Visitors: Departmental Representative or designated representatives and representatives of regulatory agencies.

.3 Occupied Area: areas of building or work site that is outside Work Area.

.4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

.5 Airlock: ingress or egress system, without permitting air movement between contaminated area and uncontaminated area. Consisting of two curtained doorways at least 2 m apart.

.6 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another. Typically constructed as follows:

.1 Place two overlapping polyethylene sheets over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and secure other sheet along opposite vertical side of doorway.

.2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.

.3 Overlap each polyethylene sheet at openings 1.5 m on each side.

.7 Action level: employee exposure, without regard to usage of respirators, to an airborne concentration of lead of 50 micrograms per cubic meter of air calculated as 8 hour time-weighted average (TWA). Intermediate precautions for lead abatement are based on airborne lead concentrations greater than 0.05 milligrams per cubic meter of air within Work Area.

.8 Competent person: [individuals] Departmental Representative capable of identifying existing lead hazards in workplace and taking corrective measures to eliminate them.

.9 Lead in Dust: wipe sampling on vertical and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.

1.5 SUBMITTALS

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

.2 Provide proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of lead based paint waste in accordance with requirements of authority having jurisdiction.

.3 Provide: Provincial and local requirements for Notice of Project Form.

.4 Provide proof of Contractor's General and Environmental Liability Insurance.

.5 Quality Control:

.1 Provide Departmental Representative necessary permits for transportation and disposal of lead based paint waste and proof that it has been received and properly disposed.

.2 Provide proof satisfactory to Departmental Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, entry and exit from Work Area, and aspects of work procedures and protective measures.

.3 Provide proof that supervisory personnel have attended lead abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.6 Product data:

.1 Provide documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:

.1 Encapsulants.

.2 Amended water.

.3 Slow drying sealer.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to lead paint, in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Safety Requirements: worker and visitor protection.

.3 Protective equipment and clothing to be worn by workers and visitors in Work Area includes:

.1 Respirator NIOSH approved and equipped with filter cartridges with assigned protection factor of 50, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure in Lead Work Area. Provide sufficient filters so workers can install new filters following disposal of used filters and before re-entering contaminated areas.

.2 Disposable type protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.

.3 Requirements for workers:

.1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters, clean coveralls and head covers before entering Equipment and Access Rooms or Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.

.2 Remove gross contamination from clothing before leaving work area. Place contaminated work suits in receptacles for disposal with other lead - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. When not in use in Work Area, store work footwear in Equipment and Access Room. Upon completion of lead abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from Work Area or from Equipment and Access Room.

.3 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers not to use this system as means to leave or enter work area.

.4 Eating, drinking, chewing, and smoking are not permitted in Work Area.

.5 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual lead abatement.

.6 Ensure workers wash hands and face when leaving Work Area. Facilities for washing are the responsibility of the Contractor.

.7 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.

.8 Ensure no person required to enter Work Area has facial hair that affects seal between respirator and face.

.8 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to Work Areas.

.2 Instruct Authorized Visitors in use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.3 Disposal of lead waste generated by removal activities must comply with Federal, Provincial, and Municipal regulations. Dispose of lead waste in sealed double thickness 0.152 mm thick bags or leak proof drums. Label containers with appropriate warning labels.

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

.1 Refer to Appendix A, Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 10, 2015 and Appendix B, Final Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 15, 2015. These are for general information only and are not necessarily representative of lead containing materials covered within scope of this Project.

.2 Notify Departmental Representative of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 SCHEDULING

.1 Not later than two days before beginning Work on this Project notify the following in writing, where appropriate:

.1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.

.2 Provincial Ministry of Labour.

.3 Disposal Authority.

.2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.

.3 Provide Departmental Representative copy of notifications prior to start of Work.

.4 Coordinate schedule with Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Polyethylene: 0.15 mm unless otherwise specified; in sheet size to minimize joints.

.2 FR polyethylene: 0.15 mm woven fibre reinforced fabric bonded both sides with polyethylene.

.3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

.4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for trapping residual lead paint residue.

.5 Lead waste containers: [metal] [fibre] type acceptable to dump operator with tightly fitting covers and 0.15 mm sealable polyethylene liners.

.1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

Part 3 EXECUTION

3.1 SUPERVISION

.1 Approved Supervisor must remain within Lead Work Area during disturbance, removal, or other handling of lead based paints.

3.2 PREPARATION

.1 Remove and wrap items to be salvaged or reused, and transport and store in area specified by Departmental Representative.

.2 Work Area:

.1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.

.2 Pre-clean fixed casework, and equipment within work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.

.3 Clean work areas using HEPA vacuum. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum.

.4 Seal off openings, corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.

.5 Cover floor surfaces in work area from wall to wall with FR polyethylene drop sheets to protect existing floor during removal.

.6 Build airlocks at entrances and exits from work areas to ensure work areas are always closed off by one curtained doorway when workers enter or exit.

.7 At point of access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used:

.1 CAUTION LEAD HAZARD AREA (25 mm).

.2 NO UNAUTHORIZED ENTRY (19 mm).

.3 WEAR ASSIGNED PROTECTIVE EQUIPMENT AND RESPIRATOR (19 mm).

.4 BREATHING LEAD CONTAMINATED DUST CAUSES SERIOUS BODILY HARM (7 mm).

.8 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Authority having jurisdiction.

.9 Where water application is required for wetting lead containing materials, provide temporary water supply by use of appropriately sized hoses for application of water as required.

.10 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.

.3 Worker Decontamination Enclosure System:

.1 Worker Decontamination Enclosure System includes Equipment and Access Room and Clean Room, as follows:

.1 Equipment and Access Room: construct between exit and work areas, with two curtained doorways, one to the rest of suite, and one to work area. Install waste receptor and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build large enough to accommodate specified facilities, equipment needed, and at least one worker allowing sufficient space to change comfortably.

.2 Clean Room: construct with curtained doorway to outside of enclosures. Provide lockers or hangers and hooks 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.

.4 Construction of Decontamination Enclosures:

.1 Construct framing for enclosures or use existing rooms. Line enclosure with polyethylene sheeting and seal with tape, apply two layers of FR polyethylene on floor.

.2 Construct curtain doorways between enclosures so when people move through or waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.

.5 Separation of Work Areas from Occupied Areas

.1 Barriers between Work Area and occupied area to be constructed as follows:

.1 Construct floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting and seal with duct tape. Apply plywood over polyethylene sheeting. Seal plywood joints and between adjacent materials with surface film forming sealer, to create airtight barrier.

.2 Cover plywood with polyethylene sheeting and sealed with duct tape.

.6 Maintenance of Enclosures:

.1 Maintain enclosures in clean condition.

.2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately.

.3 Visually inspect enclosures at beginning of each work day.

.4 Use smoke test method to test effectiveness of barriers as directed by Departmental Representative.

3.3 LEAD - BASE PAINT ABATEMENT

.1 Removal of lead based paint to be performed by scraping or sanding using non-powered hand tools, or manual demolition of lead-painted plaster walls or building components by striking a wall with sledgehammer or similar tool.

.2 Remove lead based paint in small sections and pack as it is being removed in sealable 0.15 mm plastic bags and place in labelled containers for transport.

.3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.

.4 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.

.5 After wire brushing and wet sponging to remove visible lead based paint, and after encapsulating lead containing material impossible to remove, wet clean work area including equipment and access room, and equipment used in process. After inspection by Departmental Representative, apply continuous coat of slow drying sealer to surfaces. Do not disturb work for 8 hours with no entry, activity, ventilation or disturbance during this period.

.6 After enclosing lead painted surfaces, wet clean work area and equipment and access room. During settling period no entry, activity, or ventilation will be permitted.

3.4 INSPECTION

.1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by Departmental Representative will result in work stoppage, at no cost to Departmental Representative.

.2 Departmental Representative will inspect work for:

.1 Adherence to specific procedures and materials.

.2 Final cleanliness and completion.

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

.3 When lead dust leakage from Work Area occurs Departmental Representative may order Work shutdown.

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

3.5 LEAD SURFACE SAMPLING - WORK AREAS

.1 Final lead surface sampling to be conducted as follows:

.2 After Work Area has passed a visual inspection for cleanliness approved by Departmental Representative and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period of 8 hours has passed. Departmental Representative will perform lead wipe sampling in Work Area.

.1 Final lead wipe sampling results from horizontal and vertical surfaces where lead based paints have been removed must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples must be collected and analyzed in accordance with EPA 747-R-95-007.

.2 If wipe sampling results show levels of lead in excess of 40 micrograms per square foot, re-clean work area at contractor's expense and apply another acceptable coat of lock-down agent to surfaces.

.3 Repeat as necessary until fibre levels are less than 40 micrograms per square foot.

3.6 FINAL CLEANUP

.1 Following specified cleaning procedures, and when lead wipe sampling is below acceptable concentrations proceed with final cleanup.

.2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum equipment.

.3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.

.4 Clean-up Work Areas, Equipment and Access Room, and other contaminated enclosures.

.5 Clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.

.6 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

3.7 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS

.1 Repair or replace objects damaged in course of work to their original state or better, as directed by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Abrasive blasting of lead paint from structural steel at new steel reinforcement locations to facilitate the construction of the New Penthouse and or new equipment at R&L, R&D, WTC and Hydraulics Buildings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-Z180.1-00(R2005), Compressed Breathing Air and Systems.

.2 Department of Justice Canada

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada

.1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).

.4 Human Resources and Social Development Canada (HRSDC)

.1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.

.5 Ontario Ministry of Labour

.1 O. Reg 490/09, Designated Substances as amended by O. Reg. 148/12 and O. Reg. 149/12.

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.7 U.S. Environmental Protection Agency (EPA)

.1 EPA 747-R-95-007-1995, Sampling House Dust for Lead.

.8 U.S. Department of Health and Human Services/Centers for Disease Control and

.1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).

.9 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances

.1 Lead in Construction Regulation - 29 CFR 1926.62-1993.

.10 Underwriters' Laboratories of Canada (ULC)

.11 Occupational Health and Safety Branch, Guideline Lead On Construction Projects, September 2004, O. Reg. 490/09 respecting Designated Substances - Lead made under the Occupational Health and Safety Act as amended by O. Reg. 148/12 and O. Reg. 149/12.

1.3 DEFINITIONS

.1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Authorized Visitors: Departmental Representative or designated representatives of regulatory agencies.

.3 Occupied Area: area of building or work site outside Work Area.

.4 Dioctyl Phthalate (DOP) Test: testing method used to evaluate particle penetration and air flow resistance properties of filtration materials - HEPA filter leak test.

.5 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Appropriate capacity for scope of work.

.6 Airlock: ingress or egress system without permitting air movement between contaminated area and uncontaminated area. Consisting of two curtained doorways at least 2 m apart.

.7 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:

.1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.

.2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.

.3 Overlap each polyethylene sheet at openings 1.5 m on each side.

.8 Action level: employee exposure, without regard to usage of respirators, to an airborne concentration of lead of 50 micrograms per cubic metre of air calculated as an 8-hour time-weighted average (TWA). Maximum precautions for lead abatement are based on airborne lead concentrations greater than 1.25 milligrams per cubic meter of air within Work Area.

.9 Competent person: Departmental Representative capable of identifying existing lead hazards in workplace and taking corrective measures to eliminate them.

.10 Lead in Dust: wipe sampling on the vertical and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.

.11 Negative Air Pressure Machine: extracts air directly from work area and filters extracted air through a HEPA filter, discharge air to exterior of building.

.1 Maintain pressure differential of 5 to 7 Pa relative to adjacent areas outside of work areas. Machine to be equipped with alarm to warn of system breakdown, and equipped with instrument to continuously monitor and automatically record pressure differences.

1.4 SUBMITTALS

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

.2 Provide proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of lead based paint waste in accordance with requirements of authority having jurisdiction.

.3 Provide: Provincial and local requirements for Notice of Project Form.

.4 Provide proof of Contractor's General and Environmental Liability Insurance.

.5 Quality Control:

.1 Provide Departmental Representative necessary permits for transportation and disposal of lead based paint waste and proof it has been received and properly disposed.

.2 Provide proof satisfactory to Departmental Representative that employees had instruction on hazards of lead exposure, respirator use, dress, entry and exit from Work Area, and aspects of work procedures and protective measures.

.3 Provide proof that supervisory personnel have attended lead abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.6 Product data:

.1 Provide documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:

.1 Encapsulants.

.2 Amended water.

.3 Slow drying sealer.

1.5 QUALITY ASSURANCE

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

.2 Health and Safety:

.1 Require construction work to be in compliance with the occupational health and safety regulations in 01 35 29.

.2 Safety Requirements: worker and visitor protection.

.3 Protective equipment and clothing to be worn by workers while in Lead Work Area includes:

.1 Leads removal using power tool: respirator NIOSH approved and equipped with filter cartridges with assigned protection factor of 50, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure in Lead Work Area. Provide sufficient filters so workers can install new filters following disposal of used filters and before re-entering contaminated areas.

.2 Abrasive blasting of lead paint: NIOSH approved and equipped with filter cartridges with assigned protection factor of 1000, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure in Lead Work Area. Respirator to be equivalent Type CE abrasive blast supplied air respirator operated in a pressure demand or positive pressure mode with a tight-fitting full-face-piece. Compressed air used to supply supplied air respirators to meet breathing air purity requirements of CAN/CSA-Z180.1. Where an oil-lubricated compressor is used to supply breathing air, a continuous carbon monoxide monitor/alarm to be provided.

.3 Disposable protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.

.4 Requirements for workers:

.1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters, clean coveralls and head covers before entering Equipment and Access Rooms or Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.

.2 Remove gross contamination from clothing before leaving work area. Place contaminated work suits in receptacles for disposal with other lead contaminated materials. Leave reusable items except respirator in Equipment and Access Room. When not in use in work area, store work footwear in Equipment and Access Room. Upon completion of lead abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from work area or from Equipment and Access Room.

.3 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers not use this system as means to leave or enter Work Area.

.5 Eating, drinking, chewing, and smoking are not permitted in Work Area.

.6 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual lead abatement.

.7 Ensure workers wash hands and face when leaving Lead Work Area. Facilities for washing are the responsibility of the Contractor.

.8 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.

.9 Ensure no person required to enter Work Area has facial hair that affects seal between respirator and face.

.10 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

.2 Instruct Authorized Visitors in use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Work Area.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.3 Disposal of lead waste generated by removal activities must comply with Federal, Provincial, and Municipal regulations. Dispose of lead waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.7 EXISTING CONDITIONS

.1 Refer to Appendix A, Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 10, 2015 and Appendix B, Final Designated Substances and Hazardous Materials Surveys for 867 Lakeshore Road, Burlington Ontario, dated July 15, 2015. These are for general information only and are not necessarily representative of asbestos containing materials covered within scope of this Project.

.2 Notify Departmental Representative of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.8 SCHEDULING

.1 Not later than two days before beginning Work on this Project notify the following in writing; where appropriate.

.1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.

.2 Provincial Ministry of Labour.

.3 Disposal Authority.

.2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.

.3 Provide Departmental Representative copy of notifications prior to start of Work.

.4 Coordinate schedule with Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Polyethylene 0.15 mm unless otherwise specified; in sheet size minimize joints.

.2 FR polyethylene: 0.15 mm woven fibre reinforced fabric bonded both sides with polyethylene.

.3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

.4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for trapping residual lead paint residue.

.5 Lead waste containers: metal or fibre type acceptable to dump operator with tightly fitting covers and 0.15 mm sealable polyethylene liners.

.1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

Part 3 EXECUTION

3.1 SUPERVISION

.1 Approved Supervisor must remain within Work Area during disturbance, removal, or handling of lead based paints.

3.2 PREPARATION

.1 Remove and wrap items to be salvaged or reused, and transport and store in area specified by Departmental Representative.

.2 Work Area:

.1 Shut off and isolate HVAC system to prevent lead dust and particulate dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.

.2 Pre-clean fixed casework, and equipment within work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.

.3 Clean work areas using HEPA vacuum. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum.

.4 Install negative pressure machine system and operate continuously from installation of polyethylene sheeting until completion of final cleanup. Provide automatic continuous monitoring and recording instrument of pressure difference.

.5 Seal off openings, corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.

.6 Cover floor surfaces in work area from wall to wall with FR polyethylene drop sheets to protect existing floor during removal.

.7 Build airlocks at entrances and exits from work areas to ensure work areas are always closed off by one curtained doorway when workers enter or exit.

.8 At point of access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used:

.1 CAUTION LEAD HAZARD AREA (25 mm).

.2 NO UNAUTHORIZED ENTRY (19 mm)

.3 WEAR ASSIGNED PROTECTIVE EQUIPMENT AND RESPIRATOR (19 mm).

.4 BREATHING LEAD CONTAMINATED DUST CAUSES SERIOUS BODILY HARM (7 mm).

.9 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Authority having jurisdiction.

.10 Where water application is required for wetting lead containing materials, provide temporary water supply by use of appropriately sized hoses for application of water as required.

.11 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.

.3 Worker Decontamination Enclosure System:

.1 Worker Decontamination Enclosure System includes Equipment and Access Room and Clean Room, as follows:

.1 Equipment and Access Room: construct between exit and work areas, with two curtained doorways, one to the rest of the suite, and one to work area. Install waste receptor and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build large enough to accommodate specified facilities, equipment needed, and at least one worker allowing sufficient space to change comfortably.

.2 Clean Room: construct with curtained doorway to outside of enclosures. Provide lockers or hangers and hooks 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.

.4 Construction of Decontamination Enclosures:

.1 Construct framing for enclosures or use existing rooms. Line enclosure with polyethylene sheeting and seal with tape, apply two layers of FR polyethylene on floor.

.2 Construct curtain doorways between enclosures so when people move through or waste containers and equipment are moved through doorway, one of two closure comprising doorway always remains closed.

.3 Shower room in decontamination facility to be provided with the following:

.1 Hot and cold water or water of constant temperature not less than 40 degrees Celsius or more than 50 degrees Celsius.

.2 Individual controls inside to regulate water flow and temperature.

.4 Prior to each shift in which a decontamination facility is being used, a competent person should inspect the facility to ensure that there are no defects that would allow lead-containing dust to escape. Defects should be repaired before the facility is used. The decontamination facility should be maintained in a clean and sanitary condition.

.5 Separation of Work Areas from Occupied Areas:

.1 Barriers between Work Area and occupied area to be constructed as follows:

.1 Construct floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting and seal with duct tape. Apply plywood over polyethylene sheeting. Seal plywood joints and between adjacent materials with surface film forming sealer, to create airtight barrier.

.2 Cover plywood with polyethylene sheeting and sealed with duct tape.

.6 Maintenance of Enclosures:

.1 Maintain enclosures in tidy condition.

.2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately.

.3 Visually inspect enclosures at beginning of each working day.

.4 Use smoke test method to test effectiveness of barriers as directed by Departmental Representative.

3.3 LEAD - BASE PAINT ABATEMENT

.1 Removal of lead based paint to be performed using power abrasive blasting.

.2 Remove lead based paint in small sections and pack as it is being removed in sealable 0.15 mm plastic bags and place in labelled containers for transport.

.3 Wet method to be used to reduce dust generation. Examples of wet methods include wetting surfaces, wet scraping, and wet shovelling. Wet method not be used if it creates a hazard or cause damage to equipment or to project. Power tools to be equipped with a shroud, and to be kept flush with surface.

.4 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove immediate from working area to staging area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.

.5 After completion of stripping work, wire brush and wet sponge surface to remove visible material. During this work keep surfaces wet. After wire brushing and wet sponging, wet clean and HEPA vacuum entire work area including Equipment and Access Room. Compressed air or dry sweeping not be used to clean up lead-containing dust or waste. After inspection and approval by Departmental Representative apply continuous coat of slow drying sealer to surfaces. Do not disturb work area for 8 hours, no entry, activity, or ventilation other than operation negative air machine during this period.

.6 After enclosing lead painted surfaces, wet clean work area and equipment and access room. During settling period no entry, activity, or ventilation will be permitted.

3.4 INSPECTION

.1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from requirements not been approved in writing by Departmental Representative will result in Work shutdown, at no cost to Owner.

.2 Departmental Representative will inspect work for:

.1 Adherence to specific procedures and materials.

.2 Final cleanliness and completion.

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

.3 When lead dust leakage from Work Area occurs Departmental Representative will order Work shutdown.

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

3.5 LEAD SURFACE SAMPLING - WORK AREAS

.1 Final lead surface sampling conducted as follows:

.2 After Work Area has passed a visual inspection for cleanliness approved by Departmental Representative and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period of 8 hours has passed, Departmental Representative will perform lead wipe sampling in Work Area.

.3 Final lead wipe sampling results from horizontal and vertical surfaces must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples collected and analyzed in accordance with EPA 747-R-95-007.

.4 If wipe sampling results show levels of lead dust in excess of 40 micrograms per square foot, re-clean work area at contractor's expense and apply another acceptable coat of lock-down agent to surfaces.

.5 Repeat as necessary until lead dust levels are less than 40 micrograms per square foot.

3.6 FINAL CLEANUP

.1 Following specified cleaning procedures, and when lead wipe sampling is below acceptable concentrations proceed with final cleanup.

.2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.

.3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and sealed labelled waste containers for transport.

.4 Clean up Work areas, Equipment and Access Room, and other contaminated enclosures.

.5 Remove sealed waste containers and equipment used in Work and remove from work areas at appropriate time in cleaning sequence.

.6 Conduct final check to ensure no dust or debris remain on surfaces as result of dismantling operations.

3.7 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS

.1 Repair or replace objects damaged in course of work to their original state or better, as directed by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 20 – Construction Demolition.

.2 Section 03 20 00 - Concrete Reinforcing.

.3 Section 03 30 00 - Cast-In-Place Concrete.

.4 Section 07 92 10 - Joint Sealing.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA A23.1-14/A23.2-14, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.

.2 CSA O86-14, Consolidation-Engineering Design in Wood (Limit States Design).

.3 CSA O121-08(R2014), Douglas Fir Plywood.

.4 CSA O151-09, Canadian Softwood Plywood.

.5 CAN3-O188.0-M78, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.

.6 CSA S269.1-1975(R2003), Falsework for Construction Purposes.

.7 CAN/CSA-S269.3-M92(R2013), Concrete Formwork.

1.3 SHOP DRAWINGS

.1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3, for formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

.4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

.5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20 and 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 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121.

.2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.

.2 Pan forms: Removable steel as indicated.

.3 Tubular column forms: round, spirally wound laminated fiber forms, internally treated with release material. Spiral pattern to show in hardened concrete.

.4 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface.

.2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.

.5 Form liner:

.1 Plywood: medium density overlay Douglas Fir to CSA O121 square edge, urea formaldehyde free.

.6 Form release agent: non-toxic, low VOC.

.7 Form stripping agent: colourless mineral oil, non-toxic, low VOC, free of kerosene, with viscosity between 15 to 24 mm^2/s at 40°C, flashpoint minimum 150°C, open cup.

.8 Falsework materials: to CSA S269.1.

.9 Sealant: to Section 07 92 00.

Part 3 EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.

.3 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.4 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.

.5 Align form joints and make watertight. Keep form joints to minimum.

.6 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.7 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.8 Construct forms for architectural concrete, and place ties as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

.9 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

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

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 2 days for walls and sides of beams.

.2 2 days for columns.

.3 5 days for beam soffits, slabs, decks and other structural members, or 2 days when replaced immediately with adequate shoring to standard specified for falsework.

.4 2 days for footings and abutments.

.2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.4 Space reshoring in each principal direction at not more than 3000 mm apart.

.5 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00.01 - Cast-In-Place Concrete

.2 Section 03 35 00 - Concrete Finishing.

.3 Section 04 22 00 - Concrete Unit Masonry.

1.2 REFERENCES

.1 American Concrete Institute (ACI)

.1 ACI SP-66-04, ACI Detailing Manual 2004.

.2 ASTM International

.1 ASTM A1064/A1064M-15, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.2 ASTM A1060/A1060M-11e1, Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.3 CSA International

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CSA A23.3-14, Design of Concrete Structures.

.3 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Delegated Design: Retain professional engineer, registered in the province of the Work, to determine mix design complying with the requirements of the Building Code and the Contract Documents:

.1 Certify that mix design proportions for each type of concrete specified will produce the specified strength and slump, and comply with the cement strength specified in this section.

.2 Certify that plant, equipment and materials used in concrete comply with requirements of CSA A23.1.

.3 Certify that concrete mix design will provide specified strength in accordance with the requirements of CSA A23.1.

.4 Certify that the delivered concrete complies with the reviewed mix design and the specified performance criteria prior to placing on site.

.5 Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

.6 Indicate amounts of mix water to be withheld for later addition at Project site.

.7 Mix design shall be completed by Contractor and submitted to Departmental Representative for review prior to concrete placement.

.8 Contractor shall take responsibility for mix design and provide required concrete strength as verified by testing agency.

.9 Provide a Letter of Commitment and a Letter of Compliance, signed and sealed by delegated professional engineer in accordance with Section 01 33 50 – Delegated Design Submittals.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.1 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.

.2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

1.5 QUALITY ASSURANCE

.1 Submit in accordance with Section 01 45 00 and as described in PART 2 - SOURCE QUALITY CONTROL.

.1 Mill Test Report: provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

.2 Submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

.2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:

.1 Delegated Design Professional Engineer: Retain a professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated; engineering services are defined as those performed for ascertaining mix design, design of formwork and shoring, and re-shoring installations that are similar to those indicated for this Project in material, design, and extent.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise, minimum 30% recycled content.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18, minimum 30% recycled content.

.4 Welded steel wire and deformed steel wire reinforcement: to ASTM A1064/A1064M; and zinc-coated (galvanized) steel welded wire and deformed steel welded wire reinforcement: to ASTM A1060/A1060M-14. Minimum 30% recycled content for all steel wire reinforcement.

.1 Provide in flat sheets only and adequately chair into position to obtain the specified concrete cover. Do not lay reinforcing sheets down and hook into position after concrete has been poured.

.5 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.

.6 Plain round bars: to CSA G40.20/G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Inform Departmental Representative of proposed source of material to be supplied.

Part 3 EXECUTION

3.1 FIELD BENDING

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

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel in accordance with CSA A23.1/A23.2.

.2 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened.

.2 When paint is dry, apply thick even film of mineral lubricating grease.

.3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

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

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Forming and Accessories

.2 Section 03 20 00 - Concrete Reinforcing

.3 Section 03 35 00 - Concrete Finishing.

.4 Section 04 22 00 - Concrete Unit Masonry.

1.2 MEASUREMENT REFERENCES

.1 ASTM International

.1 ASTM A1064/A1064M-15, Standard Specification for Carbon –Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete.

.2 ASTM A1060/A1060M-14, Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.3 ASTM D1751-04(2013)E1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).

.2 CSA International

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with Section 01 31 19, convene pre-installation meeting one week prior to beginning concrete works.

.1 Ensure key personnel, site supervisor, Departmental Representative attend.

.2 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:

.1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.

.2 Submit drawings showing formwork and falsework design to: CSA A23.1/A23.2.

.3 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 At least 4 weeks prior to beginning Work, inform Departmental Representative of source of fly ash.

.1 Do not change source of fly ash without written approval of Departmental Representative.

.4 At least 4 weeks prior to beginning Work, submit to Departmental Representative samples of following materials proposed for use: curing compound, joint filler, and waterstops.

.5 Provide testing and inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.6 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.5 QUALITY ASSURANCE

.1 Provide to Departmental Representative, 4 weeks minimum prior to starting concrete work, valid and recognized certificate from plant delivering concrete.

.1 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by the Departmental Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

.1 Cement: to CAN/CSA-A3001, Type GU.

.1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.

.2 Blended hydraulic cement: Type GUb to CAN/CSA-A3001.

.3 Supplementary cementing materials: with minimum 20% Type F fly ash replacement, by mass of total cementitious materials to CSA A3001.

.4 Water: to CSA A23.1/A23.2.

.5 Reinforcing bars: to CSA-G30.18, Grade 400, minimum 30% recycled content.

.6 Welded steel wire and deformed steel wire reinforcement: to ASTM A1064/A1064M; and zinc-coated (galvanized) steel welded wire and deformed steel welded wire reinforcement: to ASTM A1060/A1060M-14. Minimum 30% recycled content for all steel wire reinforcement.

.1 Provide in flat sheets only and adequately chair into position to obtain the specified concrete cover. Do not lay reinforcing sheets down and hook into position after concrete has been poured.

.7 Premoulded joint filler:

.1 Bituminous impregnated fibreboard: to ASTM D1751-04(2013)E1.

.8 Joint sealer/filler: grey to CAN/CGSB-19.24-M90, Type 1, Class B.

.9 Sealer: boiled linseed oil to ASTM D260 mixed with mineral spirits 1:1

.10 Other concrete materials: to CSA A23.1/A23.2.

2.4 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

.2 Provide concrete mix to meet following plastic state requirements:

Workability: free of surface blemishes, colour variations and segregation.

.3 Provide concrete mix to meet following hard state requirements:

.1 Durability and class of exposure: as noted on the drawings

.2 Compressive strength as noted on the drawings.

.3 Slump: as noted on the drawings.

.4 Intended application: as noted on the drawings.

.5 Aggregate size as noted on the drawings.

.6 Other Special requirements: as noted on the drawings.

.4 Concrete supplier's certification.

.5 Provide quality management plan to ensure verification of concrete quality to specified performance.

Part 3 EXECUTION

3.1 PREPARATION

.1 Provide Departmental Representative 24 hours notice before each concrete pour.

.2 Place concrete reinforcing in accordance with Section 03 20 00.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of rehandling, and without damage to existing structure or Work.

.4 Protect previous Work from staining.

.5 Clean and remove stains prior to application of concrete finishes.

3.2 INSTALLATION/ APPLICATION

.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

.2 Sleeves and inserts:

.1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required to be built-in.

.2 Sleeves and openings greater than 100 mm x 100 mm not indicated, must be reviewed by Departmental Representative.

3.3 FINISHES

.1 All concrete slabs to have class “A” finish in accordance with CSA A23.1/A23.2 Table 22.

.2 Formed surfaces exposed to view: sack rubbed finish.

.3 Interior floor slabs to be left exposed requiring smooth surface: initial finishing operations followed by final finishing comprising mechanical floating and steel trowelling as specified in CSA A23.1/A23.2 to produce hard, smooth, dense trowelled surface free from blemishes.

.4 Equipment pads: provide smooth trowelled surface.

.5 Pavements, walks, curbs and exposed site concrete:

.1 Screed to plane surfaces and use aluminum floats.

.2 Provide round edges and joint spacings using standard tools.

.3 Trowel smooth to provide lightly brushed non-slip finish.

3.4 CONTROL JOINTS

.1 Cut and Form control joints in slabs on grade at locations indicated, to CSA A23.1/A23.2 and install specified joint sealer/filler.

3.5 EXPANSION AND ISOLATION JOINTS

.1 Install premoulded joint filler in expansion and isolation joints full depth of slab flush with finished surface to CSA A23.1/A23.2.

3.6 CURING

.1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.7 SEALING APPLICATION

.1 After curing is complete, apply two even coats of linseed oil mixture to clean dry surfaces, each at 8 m^2 /L. Allow first coat to dry before applying second coat.

3.8 SITE TOLERANCES

.1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.

3.9 FIELD QUALITY CONTROL

.1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Departmental Representative.

3.10 CLEANING

.1 Clean in accordance with Section 01 74 11.

.2 Use trigger operated spray nozzles for water hoses.

.3 Designate cleaning area for tools to limit water use and runoff.

.4 Cleaning of concrete equipment to be done in accordance with Section 01 35 29.

.5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.1 Use excess concrete for mud slab and footing bottom.

.2 Divert unused concrete materials from landfill to local quarry or facility after receipt of written approval from Departmental Representative.

.3 Provide appropriate area on job site where concrete trucks and be safely washed.

.4 Divert admixtures and additive materials from landfill to approved official hazardous material collections site after receipt of written approval from Departmental Representative.

.5 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 20 – Construction Demolition.

.2 Section 03 03 00.01 – Cast-in-place concrete.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-25.20-95, Surface Sealer for Floors.

.2 CSA International

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.3 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005(June 2006), Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Provide two copies of WHMIS MSDS. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.

.2 Include application instructions for concrete floor treatments.

1.4 ENVIRONMENTAL REQUIREMENTS

.1 Temporary lighting:

.1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.

.2 Electrical power:

.1 Provide sufficient electrical power to operate equipment normally used during construction.

.3 Work area:

.1 Make work area water tight protected against rain and detrimental weather conditions.

.4 Temperature:

.1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

.5 Moisture:

.1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.

.6 Safety:

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.7 Ventilation:

.1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00.

.3 Provide continuous ventilation during and after coating application.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

.1 Product quality and quality of work in accordance with Section 01 61 00.

.2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

2.2 CHEMICAL HARDENERS

.1 Type 1 - Sodium silicate.

.2 Water: potable.

2.3 SEALING COMPOUNDS

.1 Surface sealer: to CAN/CGSB-25.20, Type 1 - solvent-based clear.

.2 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.3 Surface sealers are not manufactured or formulated with aromatic solvents.

2.4 CURING COMPOUNDS

.1 Select low VOC, water-based curing compounds.

2.5 CONCRETE STAINS

.1 Select low VOC, water-based concrete stains.

2.6 MIXES

.1 Mixing ratios in accordance with manufacturer's written instructions.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verify that slab surfaces are ready to receive work and elevations are as indicated on shop drawings.

3.2 PREPARATION OF EXISTING SLAB

.1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges.

.2 Saw cut control joints to CSA A23.1/A23.2, 24 hours maximum after placing of concrete.

.3 Use mechanical stripping to remove chlorinated rubber or existing surface coatings.

.4 Use protective clothing, eye protection, respiratory equipment during stripping of chlorinated rubber or existing surface coatings.

3.3 APPLICATION

.1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.

.2 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.

.3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.

.4 Clean over spray. Clean sealant from adjacent surfaces.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.5 PROTECTION

.1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 05 12 - Mortar and Masonry Grout.

.2 Section 04 05 19 - Masonry Anchorage and Reinforcing.

.3 Section 04 22 00 - Concrete Unit Masonry.

.4 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

.1 CSA Group

.1 CSA A165 Series-14, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.2 CSA A179-14, Mortar and Grout for Unit Masonry.

.3 CSA A371-14, Masonry Construction for Buildings.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: comply with Section 01 31 19. Conduct pre-installation meeting one week prior to commencing work of this Section to:

.1 Verify project requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Co-ordinate with other building subtrades.

.6 Review manufacturer's installation instructions.

.7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.

.8 Review warranty requirements.

.2 Sequencing: sequence with other work in accordance with Section 01 32 16. Comply with manufacturer's written recommendations for sequencing construction operations.

.3 Scheduling: schedule with other work in accordance with Section 01 32 16.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for masonry 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.

.3 Samples:

.1 Provide samples as follows:

.1 2 of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19.

.4 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.

.5 Test and Evaluation Reports:

.1 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.

.2 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.

.6 Installation Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

1.5 CLOSEOUT SUBMITTALS

.1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00.

1.6 EXTRA MATERIALS

.1 Submit manufacturer's instructions in accordance with Section 01 78 00 covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 or indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect material from nicks, scratches, and blemishes.

.3 Keep materials dry until use.

.4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

.5 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in accordance with Section 01 74 20.

1.8 SITE CONDITIONS

.1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.

.2 Weather Requirements: to CSA A371.

.3 Cold weather requirements:

.1 To CSA A371 with following requirements.

.1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.

.2 Maintain ambient temperature of masonry work and its constituent materials between 5 degrees C and 50 degrees C and protect site from windchill.

.3 Maintain temperature of masonry above 0 degrees C for minimum of 3 days, after mortar is installed.

.4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.

.2 Hot weather requirements:

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

.3 Spray mortar surface at intervals and keep moist for maximum of 3 days after installation.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Masonry materials are specified elsewhere in Related Requirements.

Part 3 EXECUTION

3.1 INSTALLERS

.1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.

.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Departmental Representative.

.3 Verification of Conditions:

.1 Verify that:

.1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete block.

.2 Field conditions are acceptable and are ready to receive work.

.3 Built-in items are in proper location, and ready for roughing into masonry work.

.2 Commencing installation means acceptance of existing substrates.

3.3 PREPARATION

.1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

.2 Establish and protect lines, levels, and coursing.

.3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

.1 Do masonry work in accordance with CSA A371 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CSA A371.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

.1 Exposed masonry:

.1 Remove chipped, cracked, and otherwise damaged units, in accordance with CSA A165, in exposed masonry and replace with undamaged units.

.2 Jointing:

.1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.

.3 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.4 Building-In:

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

.5 Support of loads:

.1 Use 20 MPa concrete to Section 03 30 00, where concrete fill is used in lieu of solid units.

.2 Use grout to CSA A179 where grout is used in lieu of solid units.

.3 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.

.6 Provision for movement:

.1 Leave 3 mm space below shelf angles.

.2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.3 Built masonry to tie in with stabilizers, with provision for vertical movement.

.7 Loose steel lintels:

.1 Install loose steel lintels. Center over opening width.

.8 Interface with other work:

.1 Cut openings in existing work as indicated.

.2 Openings in walls: reviewed by Departmental Representative.

.3 Make good existing work. Use materials to match existing.

3.6 SITE TOLERANCES

.1 Tolerances in notes to CSA A371 apply.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection:

.1 Perform field inspection and testing in accordance with Section 01 45 00.

.2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.9 PROTECTION

.1 Temporary Bracing:

.1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

.2 Bracing approved by Departmental Representative.

.3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 Moisture Protection:

.1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.

.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

.3 Air Temperature Protection: protect completed masonry as recommended in 1.8, SITE CONDITIONS.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 05 00 – Common Work Results for Masonry

.2 Section 04 05 19 – Masonry Anchorage and Reinforcing

.3 Section 04 22 00 – Concrete Unit Masonry

1.2 REFERENCES

.1 CSA Group

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CSA A179-14, Mortar and Grout for Unit Masonry.

.3 CSA A371-14, Masonry Construction for Buildings.

.4 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.2 South Coast Air Quality Management District (SCAQMD)

.1 SCAQMD Rule 1168-05, Adhesive and Sealant 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 masonry mortar and grout 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. Indicate VOC's mortar, grout, and admixtures. Expressed as grams per litre (g/L).

.3 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CSA A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00.

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 In accordance with Section 04 05 00.

1.6 SITE CONDITIONS

.1 Ambient Conditions: maintain materials and surrounding air temperature to:

.1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Weather Requirements: In accordance CSA A371 and as specified in Section 04 05 00.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Use same brands of materials and source of aggregate for entire project.

.2 Cement:

.1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10) gray colour.

.1 Use low VOC products in compliance with SCAQMD Rule 1168.

.2 Masonry Cement: to CAN/CSA-A3002 and CSA A179, Type N.

.3 Mortar Cement: to CAN/CSA-A3002 and CSA A179, Type N.

.1 Use low VOC products in compliance with SCAQMD Rule 1168.

.4 Packaged Dry Combined Materials for mortar: to CSA A179, Type N, using gray colour cement.

.3 Aggregate: supplied by one supplier.

.1 Fine Aggregate: to CSA A179, natural sand.

.2 Course Aggregate: to CSA A179.

.4 Water: clean and potable.

.5 Lime:

.1 Hydrated Lime: to CSA A179, Type S.

.6 Bonding Agent: latex type.

.7 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 MORTAR MIXES

.1 Mortar for interior masonry:

.1 Load Bearing: type N based on property specifications.

.2 Non-Load Bearing: O based on property specifications.

2.3 MORTAR MIXING

.1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.

.2 Mix mortar ingredients in accordance with CSA A179 in quantities needed for immediate use.

.3 Maintain sand uniformly damp immediately before mixing process.

.4 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.

.5 Do not add air entraining admixture to mortar mix.

.6 Use a batch type mixer in accordance with CSA A179.

.7 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

.8 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 10 degrees C.

2.4 GROUT MIXES

.1 Bond Beams: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; mixed in accordance with CSA A179 fine grout.

.2 Lintels: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; mixed in accordance with CSA A179 fine grout.

.3 Grout: Minimum compressive strength of 12.5 MPa at 28 days. Maximum aggregate size and grout slump: CSA A179.

2.5 GROUT MIXING

.1 Mix grout ingredients in quantities needed for immediate use in accordance with CSA A179 fine grout.

.2 Add admixtures in accordance with manufacturer's instructions; mix uniformly.

.3 Do not use calcium chloride or chloride based admixtures.

2.6 MIX TESTS

.1 Testing Mortar Mix:

.1 Test mortar to requirements of Section 01 45 00, and in accordance with CSA1 79, for mortar based on property specification. Test prior to construction and during construction for:

.1 Compressive strength.

.2 Consistency.

.3 Mortar aggregate ratio.

.4 Sand/cement ratio.

.5 Water content and water/cement ratio.

.6 Air content.

.7 Splitting tensile strength.

.2 Testing Grout Mix:

.1 Test grout to requirements of Section 01 45 00 and in accordance with CSA A179, for grout based on property specification. Test prior to construction and during construction for:

.1 Compressive strength.

.2 Sand/cement ratio.

.3 Water content and water/cement ratio.

.4 Slump.

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 masonry installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Apply bonding agent to existing concrete surfaces.

.2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 CONSTRUCTION

.1 Do masonry mortar and grout work in accordance with CSA A179 except where specified otherwise.

3.4 MIXING

.1 Clean all mixing boards and mechanical mixing machine between batches.

.2 Mortar must be weaker than the units it is binding.

.3 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.5 MORTAR PLACEMENT

.1 Install mortar to requirements of CSA A179.

.2 Remove excess mortar from grout spaces.

3.6 GROUT PLACEMENT

.1 Install grout in accordance with manufacturer's instructions.

.2 Install grout in accordance with CSA A179.

.3 Work grout into masonry cores and cavities to eliminate voids.

.4 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.

.5 Do not displace reinforcement while placing grout.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 04 05 00 supplemented as follows:

.1 Test and evaluate mortar prior to construction and during construction in accordance with CSA A179.

.2 Test and evaluate grout prior to construction and during construction to CSA A179; test in conjunction with masonry unit sections specified.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Remove droppings and splashings using clean sponge and water.

.3 Clean masonry with low pressure clean water and soft natural bristle brush.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.9 PROTECTION

.1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 05 00 – Common Work Results for Masonry

.2 Section 04 05 12 - Mortar and Masonry Grout.

.3 Section 04 22 00 - Concrete Unit Masonry.

1.2 REFERENCES

.1 ASTM International

- .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
- .2 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

.2 CSA Group

- .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CSA A179-14, Mortar and Grout for Unit Masonry.
- .3 CSA A370-14, Connectors for Masonry.
- .4 CSA A371-14, Masonry Construction for Buildings.
- .5 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .6 CSA S304.1-14, Design of Masonry Structures.
- .7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC)

- .1 Reinforcing Steel Manual of Standard Practice, 2004.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for anchorage and reinforcing materials and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00.

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

1.5 SITE MEASUREMENTS

.1 Make site measurements necessary to ensure proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

.1 In accordance with Section 04 05 00.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Bar reinforcement: Steel to CSA A371 and CSA G30.18, Grade 400.

.2 Connectors: to CSA A370 and CSA S304.1.

.3 Corrosion protection: to CSA S304.1.

.4 Fasteners: installed post-construction:

.1 Screw Shields and Plugs: plastic or nylon, placed directly into solid masonry units.

.2 Bolts and Screws: size and type to suit application, locate where indicated.

.3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.

.4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.

.5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.

.5 Ties: uncoated steel finish.

.1 Joint Reinforcement Ties: to CSA A370:

.1 Single Wythe Joint Reinforcement: ladder type:

.1 Cold drawn steel wire conforming to ASTM A82/A82M.

.6 Anchors: to CSA A370:

.1 Wedge Anchors: expansion anchors type wedge and bolt, sized to suit application.

.2 Self-Contained Anchors: type double-glass/plastic vial system, with epoxy resin and hardener.

.3 Anchor Bolts: conventional (unpatented) anchors, steel, uncoated finish.

.7 Conventional Bolts:

.1 Bolts: to ASTM A36/A36M, bar stock shop threaded, straight bolts with square or hex-headed nuts.

.2 Plate anchors: steel to ASTM A36/A36M, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.

.3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36/A36M bar stock.

.8 Adhesive Anchors: proprietary systems, pre-mixed, self-contained system with double glass vial system to contain epoxy, consisting of resin, hardener and aggregate.

2.2 FABRICATION

.1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Fabricate connectors in accordance with CSA A370.

.3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on placing drawings.

.4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcement work.

.2 Upon request inform Departmental Representative of proposed source of material to be supplied.

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 anchorage and reinforcing materials installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

.1 Supply and install masonry connectors and reinforcement in accordance with CSA A370, CSA A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.

.2 Prior to placing concrete, mortar or grout, obtain Departmental Representative's approval of placement of reinforcement and connectors.

.3 Supply and install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

.1 Install unit, adjustable, single wythe joint reinforcement where indicated and in accordance with CSA A370 and CSA A371 and in accordance with manufacturer's instructions.

.1 Install horizontal joint reinforcement 400 mm on centre.

.2 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.

.3 Place joint reinforcement continuous in first and second joint below top of walls.

.4 Lap joint reinforcement ends minimum 150 mm.

3.5 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1, CSA A371, and CSA A179.

.3 Support and position reinforcing bars in accordance with CSA A371.

3.6 GROUTING

.1 Grout masonry in accordance with CSA S304.1, CSA A371 and CSA A179 and as indicated.

3.7 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.8 FIELD BENDING

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars and connectors which develop cracks or splits.

3.9 FIELD QUALITY CONTROL

.1 Site inspections in accordance with Section 04 05 00.

.2 Obtain Departmental Representative approval of placement of reinforcement and connectors, prior to placing mortar or grout.

3.10 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 05 00 – Common Work Results for Masonry

.2 Section 04 05 12 - Mortar and Masonry Grout.

.3 Section 04 05 19 – Masonry Anchorage and Reinforcing

.4 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

.1 CSA Group

.1 CSA A165 Series-14, CSA Standards on Concrete Masonry Units consists: A165.1, A165.2, A165.3.

.2 CSA A371-14, Masonry Construction for Buildings.

.3 CSA S304-14, Design of Masonry Structures.

.2 South Coast Air Quality Management District (SCAQMD)

.1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00.

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 In accordance with Section 04 05 00 and as follows:

.2 Delivery and Acceptance Requirements:

.1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.

.2 Do not use brick tongs to move or handle masonry.

.3 Storage and Handling Requirements:

.1 Do not double stack cubes of concrete unit masonry.

.2 Cover masonry units with non-staining waterproof membrane covering.

.3 Allow air circulation around units.

.4 Installation of wet or stained masonry units is prohibited.

.5 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.

.6 Store and protect concrete unit masonry from nicks, scratches, and blemishes.

.7 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Standard concrete block units: to CSA A165 Series (CSA A165.1).

.1 Classification: H/15/D/M.

.2 Dimensions Nominal: width as indicated x 200 mm high x 400 mm long.

.3 Special shapes: provide square units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

.2 Fire rated concrete block units: to CSA A165 Series (CSA A165.1) as modified below.

.1 Classification: H/15/D/M except as modified by fire resistance requirements specified below.

.1 Concrete Composition: Type $L_2$30S Concrete.

.2 Fire resistant characteristics: aggregate used in units and equivalent thickness of units to the National Building Code of Canada 2010, subsections D-1.4 and D-1.6.

.3 Size: modular.

.4 Special shapes: provide square units for exposed corners. Provide purpose-made shapes for lintels and bond beams and provide additional shapes as indicated.

2.2 REINFORCEMENT

.1 Reinforcement in accordance with Section 04 05 19.

2.3 CONNECTORS

.1 Connectors in accordance with Section 04 05 19.

2.4 MORTAR MIXES

.1 Mortar and mortar mixes in accordance with Section 04 05 12.

2.5 GROUT MIXES

.1 Grout and grout mixes in accordance with Section 04 05 12.

2.6 CLEANING COMPOUNDS

.1 Use low VOC products in compliance with SCAQMD Rule 1168.

.2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.7 TOLERANCES

.1 Tolerances for standard concrete unit masonry tolerances in accordance with CSA A165.1, supplemented as follows:

.1 Maximum variation between units within specific job lot not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

.2 Tolerances for architectural concrete masonry units in accordance with CSA A165.1, supplemented as follows:

.1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

.4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

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 concrete unit masonry installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

.1 Concrete block units:

.1 Bond: running.

.2 Coursing height: 200 mm for one block and one joint.

.3 Jointing: concave where exposed or where paint or other finish coating is specified.

.2 Special Shapes:

.1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.

.2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.3 End bearing: not less than 200 mm.

.4 Install special site cut shaped units.

3.4 REINFORCEMENT

.1 Install reinforcing in accordance with Section 04 05 19.

3.5 CONNECTORS

.1 Install connectors in accordance with Section 04 05 19.

3.6 MORTAR PLACEMENT

.1 Place mortar in accordance with Section 04 05 12.

3.7 GROUT PLACEMENT

.1 Place grout in accordance with Section 04 05 12.

3.8 CONSTRUCTION

.1 Cull out masonry units, in accordance with CSA A165 with chips, cracks, broken corners, excessive colour and texture variation.

.2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.

.3 Construct masonry walls using running bond unless otherwise noted.

.4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.

.5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.

.6 Install movement joints and keep free of mortar where indicated.

.7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.

.8 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.

.9 Ensure compacted head joints. Use full or face-shell joint as indicated.

.10 Tamp units firmly into place.

.11 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.

.12 Tool exposed joints concave; strike concealed joints flush.

.13 After mortar has achieved initial set up, tool joints.

.14 Do not interrupt bond below or above openings.

3.9 REPAIR/RESTORATION

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.10 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 04 05 00 supplemented as follows:

.1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Departmental Representative in accordance with CSA S304.1.

.2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Standard Concrete Unit Masonry:

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.12 PROTECTION

.1 Brace and protect concrete unit masonry in accordance with Section 04 05 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This section does not include incidental fastening that may be required for supporting, attaching or suspending non-structural steel related materials that are described in other specification sections and can include items such as architectural accessories; healthcare accessories; mechanical and electrical equipment; communications equipment; wood framing and blocking; doors, windows and louvers; and similar attached materials.

1.2 RELATED REQUIREMENTS

.1 Section 03 20 00 – Concrete Reinforcing: Reinforcing bars for adhesive set anchoring system.

.2 Section 05 05 00 – Common Work Results for Metals: Qualifications and certification requirements for this Section.

.3 Section 05 08 10 – Steel Inspection and Testing: Requirements for third party witness and verification procedures for post installed structural fastenings.

.4 Section 05 12 00 – Structural Steel Framing

.5 Section 05 41 13 – Wind Load Bearing Steel Stud Framing

.6 Section 05 51 00 Metal Stairs and Ladders: Post-installed fastenings supporting steel stairs, landings and handrails and ladders.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A193/A193M-15, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

.2 ASTM A510-13, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

.3 ASTM A767/A767M-09, Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

.4 ASTM A780/A780M-09 (R2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

.5 ASTM F593-13a, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

.6 ASTM F1554-07ae1, Standard Specification for Anchor Bolts, Steel 36, 55, and 105-ksi Yield Strength

.2 Canadian Standards Association (CSA):

.1 CSA S16-14, Design of Steel Structures, with Updates

.2 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Provide fastenings attached to other construction without delaying the Work; provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 30 00 – Administrative Requirements

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data for each type of fastener, accessory and installation tool required for the project including the following:

.1 Manufacturer's written installation requirements and setting out diagrams.

.2 Type, size, and length of anchors and fastenings required for project.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Training Certificates: Provide training certificates or letter from manufacturer indicating that installers have been tested for the anchor and fastening requirements for the project.

.2 Material Certificates: Submit test reports signed by manufacturer certifying that materials supplied to the project meet the requirements established by the specified materials:

.1 Bolts, nuts, and washers including mechanical properties and chemical analysis.

.2 Direct tension indicators.

.3 Tension control, high strength bolt-nut-washer assemblies.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications during the course of the work of this Section:

.1 Manufacturer: Use a manufacturer that provides site personnel, technical assistance and training to installers; and on-site support during installation of post-installed anchors and fastenings.

.2 Installer: Use installers that are trained by manufacturer's site engineer for project specific methods and limitations of anchor installation.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements: Store materials to permit easy access for inspection and identification; store fasteners in a protected place; clean and relubricate nuts that become dry or rusty before use.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Install adhesive anchors only when temperature of surfaces and surrounding air temperatures are within temperature range recommended in writing by fastener manufacturer.

Part 2 Products

2.1 ADHESIVE FASTENERS

.1 Anchor Rod System: Adhesive anchor system consisting of all-thread anchor rod having 45° chisel point; nut and washer matching anchor rod materials, and adhesive capsule; and as follows:

.1 Anchor Rod Material: Carbon steel meeting requirements of ASTM A307-14

.2 Minimum Ultimate Tensile Strength: Nominal 460 MPa

.3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter

.4 Nominal Length: As Indicated or to meet manufacturer's recommended embedment depths

.5 Adhesive Capsule: Two component vinyl urethane methacrylate contained within a dual chamber foil capsule

.2 Threaded Insert System: Adhesive anchor system consisting of internally threaded insert and adhesive capsule, and as follows:

.1 Threaded Insert Material: Carbon steel meeting requirements of ASTM A307-14

.2 Minimum Ultimate Tensile Strength: Nominal 460 MPa

.3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter

.4 Nominal Length: As Indicated or to meet manufacturer's recommended embedment depths

.5 Adhesive Capsule: Two component vinyl urethane methacrylate contained within a dual chamber foil capsule

.3 Reinforcing Bar System: Adhesive anchor system consisting of chisel pointed steel reinforcing bar and adhesive capsule, and as follows:

.1 Reinforcing Bar Material: Deformed bars, Grade 400 in accordance with CSA G30.18

.2 Nominal Diameter: As indicated, coordinate supply of reinforcing bar with Section 03 20 00

.3 Nominal Length: As Indicated

.4 Adhesive Capsule: Two component vinyl urethane methacrylate contained within a dual chamber foil capsule

.4 Rapid Setting Adhesive Anchor Rod System: Rapid setting adhesive anchoring system consisting of all-thread anchor rod having 45° chisel point, bond enhancing threaded rod; nut and washer matching anchor rod materials, and as follows:

.1 Anchor Rod Material: Carbon steel meeting requirements of ASTM A307-14.

.2 Minimum Ultimate Tensile Strength: Nominal 460 MPa

.3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter

.4 Nominal Length: As Indicated

.5 Adhesive: Two component, injection type vinyl urethane methacrylate low temperature application epoxy acrylate and cement with zinc coated steel and with stainless steel mesh screen tube for hollow substrates.

.5 Rapid Setting Adhesive Threaded Insert System: Adhesive anchor system consisting of internally threaded insert and adhesive, and as follows:

.1 Threaded Insert Material: Carbon steel meeting requirements of ASTM A307-14

.2 Minimum Ultimate Tensile Strength: Nominal 460 MPa

.3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter

.4 Nominal Length: As Indicated

.5 Adhesive: Two component, injection type vinyl urethane methacrylate, low temperature application epoxy acrylate and cement with zinc coated steel and with stainless steel mesh screen tube for hollow substrates

2.2 EXPANSION FASTENERS

.1 Torque Controlled Expansion Anchor System: Carbon steel, heavy duty expansion anchor system consisting of bolt, sleeve, expansion sleeve and cone and washer, and as follows:

.1 Style: Hex head bolt Threaded stud and nut

.2 Nominal Diameter: As indicated

.3 Nominal Length: As Indicated

.4 Finish: Zinc plated

.2 Undercut Expansion Anchor System: Heavy duty, self-cutting mechanical undercut anchor incorporating carbide tips and as follows:

.1 Threaded Insert Material: Sherardized Carbon Steel

.2 Type: Pre-Set

.3 Minimum Ultimate Tensile Strength: Nominal 800 MPa

.4 Nominal Diameter: As indicated but not less than M12

.5 Nominal Length: As Indicated

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify ability of concrete to withstand loading pressures before beginning of installation of products specified in this Section.

.1 Installation of products specified in this Section will denote acceptance of site conditions.

.2 Preinstallation Testing: Provide testing for post-installed anchors and, and submit a post installed anchor test report indicating results and corrective actions (if any) as follows:

.1 Test first 10 anchors to demonstrate a pullout capacity equal to four times the required service capacity after cure time established by adhesive manufacturer.

.2 Randomly test 2% of remaining anchors after cure time established by adhesive manufacturer to service load capacity; additional tests may be required where failures occur.

3.2 INSTALLATION

.1 Prepare drilled holes, clean and dry holes, and install anchors and fastenings in accordance with manufacturer's written instructions as modified by directions from manufacturer's site engineer to suit project conditions.

.2 Setting Structural Anchors and Fastenings: Set structural anchors and fastenings accurately in locations and to elevations indicated on Drawings; survey measure critical areas and components that align with other construction in accordance with Section 01 70 00 – Execution Requirements.

3.3 SITE QUALITY CONTROL

.1 Post Installed Fastening Testing and Inspections: Observation requirements of structural fastenings in accordance with CSA S16.

.2 Non-Conforming Work: Remove and replace non-conforming work at no additional expense to the Work using methods and materials acceptable to the Consultant.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 05 31 00 - Steel Decking.

.3 Section 05 50 00 – Metal Fabrications.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM A36/A36M-12, Standard Specification for Structural Steel.

.2 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A193/A193M-12b, Standard Specification for Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

.4 ASTM A307-12, Standard Specification for Carbon Steel Bots and Studs, 60,000 PSI Tensile Strength.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA).

.1 CISC/CPMA 1-73b, Quick-Drying One-Coat Paint for Use on Structural Steel.

.2 CISC/CPMA 2-75, Quick-Drying Primer for use on Structural Steel.

.4 Canadian Standards Association (CSA)

.1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA S16-09, Design of Steel Structures.

.3 CSA S136-12 Package, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.

.5 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

.6 CSA W55.3-08(R2013), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.7 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric.

.5 Master Painters Institute

.1 Architectural Painting Specification Manual

.6 The Society for Protective Coatings (SSPC)

.1 SSPC SP 6/NACE No. 3-00, Commercial Blast Cleaning.

1.3 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CSA S16 and CSA S136 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non standard connections.

1.4 SHOP DRAWINGS

.1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00.

.2 Erection drawings: indicate details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Type of equipment used in erection.

.4 Temporary bracings.

.3 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of Ontario, Canada.

1.5 QUALITY ASSURANCE

.1 Submit 2 copies of mill test reports 4 weeks prior to fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Provide mill test reports certified by metallurgists qualified to practice in province of Ontario, Canada.

.2 Provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

.1 Delegated Design Engineer: Retain a professional engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including the following:

.1 Seal and signature to fabrication and erection documents and design submittals

.2 Site review of installed components.

.3 Completion of Letters or Commitment and Supervision specified in Section 01 33 50

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.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 container for recycling.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.5 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.

.6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CAN/ G40.20/G40.21, Grade 350W for W and HSS sections, 300W for plates, bars, angles and channels; minimum 75% recycled content for all steel.

.2 Welding materials: to CSA W59 and certified by CWB.

.3 Welding electrodes: to CSA W48 Series.

.4 Unheaded Rods: ASTM A36/A36M.

.5 Headed Bolts: ASTM A325/A325M, Type 1; heavy hex steel structural bolts and heavy hex carbon steel nuts.

.6 Washers: ASTM A36/A36M.

.7 Shop paint primer: to CISC/CPMA 1 for interior steel, and CISC/CPMA 2 for exterior steel.

.8 Hot dip galvanizing: galvanize steel, where indicated, to ASTM A123/A123M, minimum zinc coating of 600 g/m^2, Coating Grade 85.

2.2 FABRICATION

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

.2 Continuously seal members by continuous welds where indicated. Grind smooth.

2.3 SHOP PAINTING

.1 Clean, prepare surfaces and shop prime structural steel in accordance with CSA S16except where members to be encased in concrete.

.2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC-SP-6.

.3 Apply one coat of primer in shop to steel surfaces, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces to receive field installed stud shear connections.

.3 Surfaces and edges to be field welded.

.4 Faying surfaces of friction-type connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 EXECUTION

3.1 GENERAL

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

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 01 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.3 MARKING

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

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

3.4 ERECTION

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

.2 Field cutting or altering structural members: to approval of Departmental Representative.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.

.3 Submit test reports to Departmental Representative within 2 weeks of completion of inspection.

.4 Departmental Representative will pay costs of tests as specified in Section 01 29 83.

3.6 FIELD PAINTING

.1 Paint in accordance with Section 09 91 23.

.1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP-6 except as specified otherwise. Apply in accordance with CAN/CGSB-85.10.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 09 91 23 - Painting.

.2 Section 05 12 23 - Structural Steel for Buildings.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55%Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.79-1978(R2008), Cellular Metal and Cellular Concrete Floor Raceways and Fittings.

.2 CAN/CSA-S16-09, Design of Steel Structures.

.3 CAN/CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures.

.5 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.6 CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding) Metric.

.4 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI 10M-08, Standard for Steel Roof Deck.

.2 CSSBI 12M-08, Standard for Composite Steel Deck.

1.3 DESIGN REQUIREMENTS

.1 Design steel deck using limit states design in accordance with CAN/CSA-S136 and, CSSBI 10M and CSSBI 12M.

.2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.

.3 Deflection under specified live load not to exceed 1/240 of span, except that when gypsum board ceilings are hung directly from deck, live load deflection not to exceed 1/360 of span.

1.4 SHOP DRAWINGS

.1 Submit shop drawings erection and shoring drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit drawings stamped and signed by qualified professional engineer registered or licensed in Province of Ontario, Canada.

.3 Submit design calculations if requested by Departmental Representative.

.4 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

.5 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

1.5 QUALITY ASSURANCE

.1 Delegated Design Engineer: Retain a professional engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including the following:

.1 Seal and signature to fabrication and erection documents and design submittals

.2 Site review of installed components

.3 Completion of Letters or Commitment and Supervision specified in Section 01 33 50

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert unused metal from landfill to metal recycling facility approved by Departmental Representative.

.3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.

.4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.5 Dispose of unused caulking material at official hazardous material collections site approved by Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 255, minimum 30% recycled content, with ZF75 coating, for interior surfaces not exposed to weather, painted finish, 0.76 and 0.91mm minimum base steel thickness.

.2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.

.3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 255, minimum 30% recycled content, with ZF275, coating, regular spangle surface, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.76 and 0.91mm minimum base steel thickness.

.4 Closures: as indicated in accordance with manufacturer's recommendations.

.5 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm, minimum 30% recycled content. Metallic coating same as deck material.

.6 Primer: zinc rich, ready mix to CAN/CGSB-1.181, Ecologo certified.

.7 Caulking: to Section 07 92 00 – Joint Sealants.

2.2 TYPES OF DECKING

.1 Steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, interlocking side laps. Flat sheet for cellular deck, 0.76 mm minimum base steel thickness.

.2 Composite steel floor deck: 0.91 mm minimum base steel thickness, 38 mm deep profile, upright embossed fluted profile, interlocking side laps. Flat sheet for cellular deck, 0.91mm minimum base steel thickness.

.3 Cellular deck for electrical raceway: to CSA-C22.2 No.79.

Part 3 EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S136 and CSSBI 10M and CSSBI 12M.

.2 Welding: in accordance with CSA W59, except where specified otherwise.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

3.2 ERECTION

.1 Erect steel deck as indicated and in accordance with CAN/CSA-S136, CSSBI 10M and CSSBI 12M and in accordance with reviewed erection drawings.

.2 Lap ends: to 50 mm minimum.

.3 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

.4 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale and other foreign matter.

.5 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.

.6 Place and support reinforcing steel as indicated.

3.3 CLOSURES

.1 Install closures in accordance with approved details.

3.4 OPENINGS AND AREAS OF CONCENTRATED LOADS

.1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.

.2 Frame deck openings with any one dimension between 150 to 300 mm as recommended by manufacturer, except as otherwise indicated.

.3 For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

3.5 CONNECTIONS

.1 Install connections in accordance with CSSBI recommendations as indicated.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International

- .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .2 ASTM A123/A123M-13, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A269-10, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- .4 ASTM A307-12, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

.2 CSA International

- .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA S16-14, Design of Steel Structures.
- .3 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
- .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric.

.3 Environmental Choice Program

- .1 CCD-047-98(R2005), Architectural Surface Coatings.

.4 Green Seal Environmental Standards (GS)

- .1 GS-11-2008, 2nd Edition, Paints and Coatings.

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

- .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS.
  - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

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

1.3 QUALITY ASSURANCE

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

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Delegated Design Engineer: Retain a professional engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including the following:

.1 Seal and signature to fabrication and erection documents and design submittals

.2 Site review of installed components

.3 Completion of Letters or Commitment and Supervision specified in Section 01 33 50.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/ G40.21, Grade 350W and 300W respectively, minimum 30% recycled content.

.2 Steel pipe: to ASTM A53/A53M double extra strong, black finish, minimum 30% recycled content.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A307.

.6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

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 round 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.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2, Coating Grade 85, to ASTM A123/A123M.

.2 Shop coat primer: in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a.

.3 Zinc primer: zinc rich, ready mix in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a.

2.4 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GS-11.

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

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

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

2.5 ANGLE LINTELS

.1 Steel angles: galvanized or prime painted, sizes indicated for openings. Provide 200 mm minimum bearing at ends.

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

.3 Finish: shop painted.

.1 Primer: VOC limit 250 g/L maximum to GS-11 when applied onsite.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications 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 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

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

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

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

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16 or Weld field connection.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

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

.1 Primer: maximum VOC limit 250 g/L to GS-11.

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

.1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 PIPE RAILINGS

.1 Install pipe railings as indicated.

.2 Set railing standards in concrete. Grout to fill hole. Trowel surface smooth and flush with adjacent surfaces.

3.4 LATERAL SUPPORT ANGLES FOR MASONRY PARTITIONS

.1 Supply masonry section with steel angles to provide lateral support of masonry partitions where they abutt the underside of deck.

.2 Apply alkyd primer.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)

.1 ANSI/NAAMM MBG 531-09, Metal Bar Grating Manual.

.2 ASTM International

.1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM A325M-13, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength Metric.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 CSA International

.1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).

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

.1 Material Safety Data Sheets (MSDS).

.6 The Master Painters Institute (MPI) / Architectural Painting Specification Manual - July 2007.

.1 MPI #23 - Primer, Metal, Surface Tolerant.

.7 National Association of Architectural Metal Manufactures (NAAMM)

.1 NAAMM AMP 510-92, Metal Stair Manual.

.8 The Society for Protective Coatings (SSPC)

.1 Systems and Specifications Manual, Volume 2, 2008 Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for stairs 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 Ontario, Canada.

.2 Indicate construction details, sizes of steel sections and thickness of steel sheet.

1.3 QUALITY ASSURANCE

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

.2 Certifications: submit 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, 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect stair materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.2 Design metal stair, balustrade and landing construction and connections to NBC vertical and horizontal live load requirements.

.3 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

2.2 MATERIALS

.1 Steel sections: to CSA G40.20/G40.21 Grade 300 W, minimum 30% recycled content.

.2 Steel plate: to CSA G40.20/G40.21, Grade 260 W, minimum 30% recycled content.

.3 Floor plate: to CSA G40.20/G40.21, Grade 260 W, minimum 30% recycled content.

.1 Thickness: 5 mm.

.4 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.

.5 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with checkered plate nosings.

.6 Welding materials: to CSA W59.

.7 Bolts: to ASTM A307.

.8 High strength bolts: to ASTM A325M.

2.3 FABRICATION

.1 Fabricate in accordance with NAAMM, Metal Stair Manual.

.2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.

.3 Accurately form connections with exposed faces flush:

.1 Make mitres and joints tight.

.2 Make risers of equal height.

.4 Grind or file exposed welds and steel sections smooth.

.5 Shop fabricate stairs in sections as large and complete as practicable.

2.4 PLATE/GRATING STAIRS

.1 Form treads from 6 mm thick steel plate to profile indicated, and secure to stringers with L 35 x 35 x 5 supports. Form landings from 6 mm thick steel plate, reinforced by L 55 x 55 x 6 spaced at 600 mm on centre.

.2 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of steel grating and reinforce as required.

.3 Form stringers from MC 310 x 15.8.

2.1 PIPE BALUSTRADES

.1 Construct balusters and handrails from steel pipe.

.2 Return ends of balustrades to floor.

.3 Balusters: 38 mm Ø.

.4 Top rail: 13 mm Ø.

.5 Bottom rail: 13 mm Ø.

.6 Pickets: 13 mm Ø at maximum 100 mm on centre.

2.2 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2, Coating Grade 85, to ASTM A123/A123M.

.2 Shop coat primer: to MPI# 23.

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

2.3 SHOP PAINTING

.1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.

.2 Apply one coat of shop primer except interior surfaces of pans.

.3 Apply two coats of primer of different colours to parts inaccessible after final assembly.

.4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7 degrees C.

.5 Do not paint surfaces to be field welded.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs 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 OF STAIRS

.1 Install in accordance with NAAMM, Metal Stair Manual.

.2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.

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

.4 Do welding work in accordance with CSA W59 unless specified otherwise.

.5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

3.3 INSTALLATION OF PLASTIC HANDRAIL

.1 Apply plastic handrails in accordance with manufacturer's printed instructions, using recommended tools.

.2 Make joints and mitres neat, tight and inconspicuous. Remove surplus material from joint. Provide solid return at exposed ends of handrail.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.5 CLEANING

.1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

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

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal stairs installation.

END OF SECTION

1.1 REFERENCES

.1 CSA International

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.2 CSA O80 Series-08, Wood Preservation.

.3 CSA O80.27-1.1-08, This Standard covers the fire-retardant treatment of Douglas Fir, hardwood, softwood, and Poplar plywood by pressure processes.

.4 CSA O121-08, 2013 Douglas Fir Plywood.

.5 CAN/CSA-O141-05(R2014), Softwood Lumber.

.6 CSA O151-09, Canadian Softwood Plywood.

.7 CAN/CSA-O325.0-07, Construction Sheathing.

.8 CAN/CSA-Z809-08, Sustainable Forest Management.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 Forest Stewardship Council (FSC)

.1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

.2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.

.3 FSC Accredited Certified Bodies.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.5 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.7 National Building Code of Canada (NBC) 2010.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for rough carpentry work and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Stock Materials:

.1 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate

1.4 QUALITY ASSURANCE

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

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wood from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Lumber: unless specified otherwise, softwood, S4S, S-DRY graded and stamped, in accordance with following standards:

.1 CAN/CSA-O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.3 CAN/CSA-Z809, SFI or Forestry Stewardship Council (FSC) certified.

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

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

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

.3 Post and timbers sizes: "Standard" or better grade.

.3 Panel Materials: CAN/CSA-Z809, SFI or Forestry Stewardship Council (FSC) certified.

.1 Douglas fir plywood (DFP): to CSA O121, standard construction. Urea-formaldehyde free.

.2 Canadian softwood plywood (CSP): to CSA O151, standard construction. Urea-formaldehyde free.

.3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325. Urea-formaldehyde free.

.4 Wood Preservative:

.1 Surface-applied wood preservative: clear, copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

.2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.

.3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

2.2 ACCESSORIES

.1 Fasteners: to ASTM A123/A123M, for exterior work and pressure- preservative treated lumber.

.2 Nails, spikes and staples: to CSA B111.

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

.4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rough carpentry installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Treat surfaces of material with wood preservative, before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and 1 minute soak on plywood.

.3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

.4 Treat material as follows:

.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

3.3 INSTALLATION

.1 Comply with requirements of NBC, supplemented by the following paragraphs.

.2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

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

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

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

.6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

.7 Install sleepers as indicated.

.8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.

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

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

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section provides common design requirements relating to technical specification sections forming a part of fire and smoke rated assemblies and systems for installation by specialized Subcontractor's:

.1 Design of Rated Systems is a joint responsibility of the Departmental Representative, the Contractor, the manufacturer and installing Subcontractor, and the Authority Having Jurisdiction.

.2 Drawings indicate suggested solutions to fire and smoke rated separations, assemblies and materials using Standard Details based on generic information and time assigned materials listings listed in the Building Code for components required to meet the intent of the fire and smoke rated System

.3 Drawings do not portray complete assessment of all conditions associated with fire and smoke rated separations, assemblies and materials.

.4 Delegated design requirements of this section are included to complete the required details for the Project.

.5 Delegated design submittals are required so that the Departmental Representative can accurately and completely fulfill the requirements for the submission of schedules required by the Authorities Having Jurisdiction.

.2 This Section provides requirements for identification of fire and smoke rated assemblies common to other assemblies that reference this Section, supply and installation of identification and labelling components are the responsibility of the installing Subcontractor.

.3 It is a requirement of this Section that work relating to construction of fire and smoke rated assemblies and components is installed under the responsibility of a single source specialty firestop and smokeseal applicator or by the Contractor, or by several firestop and smokeseal applicators that are closely supervised by the Contractor in accordance with requirements forming a part of the related references included in this Section.

1.2 RELATED REQUIREMENTS

.1 Section 06 08 99 – Rough Carpentry: Fire retardant treated lumber and panels.

.2 Section 07 81 00 – Applied Fireproofing: Design of fire resistive material applied to structural members to obtain a required fire rating.

.3 Section 07 84 00 – Firestopping and Smokeseals: Design and labelling of openings through fire resistive assemblies, top-of-wall and building perimeter joints, mechanical and electrical penetrations, and other firestop or smokeseal components.

.4 Section 08 11 00 – Metal Doors and Frames: Labelling of fire rated doors and frames.

.5 Section 09 21 16 – Gypsum Board Assemblies: Labelling of fire and smoke rated assemblies and partitions.

.6 Division 21 – Fire Suppression: Labelling of fire suppression systems; coordination of firestop and smokeseals penetrations through other assemblies.

.7 Division 23 – Heating, Ventilating and Air Conditioning: Coordination of fire and smoke rated dampers and detection systems; labelling of dampers and detection systems; coordination of firestop and smokeseals penetrations through other assemblies.

.8 Division 28 – Electronic Safety and Security: Labelling of fire detection and alarm systems.

.9 Work of other sections having fire and smoke resistant construction or separation ratings.

1.3 DEFINITIONS

.1 Authority Having Jurisdiction: The local Building Code authority responsible for reviewing Engineered Judgements, Rated Systems and Mock-Ups (if any), and for inspecting installed Rated Systems for compliance with local codes and ordinances.

.2 Certified Fire Protection Specialist (CFPS): Person who has completed the NFPA sanctioned examination and professional accreditation, who is directly employed by the manufacturer, and who has direct experience in the preparation of Engineered Judgements.

.3 Engineered Judgement: A written proposal submitted by the manufacturer to the Authority Having Jurisdiction arising from a variation in the assembly or system from that tested and labelled in their Rated Systems, and as follows:

.1 Engineered Judgements are specific to this Project and details described in the written proposal and form a part of the Submittal requirements for this Section.

.2 Engineered Judgements must be signed by a CFPS, and form a part of the delegated design submittal required by this section and Section 01 33 50.

.4 Manufacturer's Authorized Representative: A person who is directly employed by the manufacturer and who is capable of making onsite decisions relating to the installation of the manufacturers Products; this person is specifically noted as not being an employee of a distributor, agent or other supplier.

.5 Rated Systems: A system that has a specific assembly rating and design or listing number assigned to it from a Recognized Testing Authority; a single example follows, additional design listings must be provided with project solutions for fire and smoke assemblies:

.1 ULC Design No. D708 – Floor Assembly: Provides the specific requirements for concrete and reinforcing, steel deck, joint covers, spray applied fire resistive materials and ratings applicable to restrained and unrestrained assemblies, and the assembly is specific to one manufacturer's product(s) in a specific testing configuration.

.2 Assemblies or systems using materials that have not been tested as a part of a Rated System, or that are not capable of obtaining an Engineered Judgement will not be acceptable for use on this Project.

.3 Materials having only a testing label from a Recognized Testing Authority will not be acceptable for use on this Project unless they form a part of a specific Rated System.

.6 Recognized Testing Authority: An organization recognized by the Authority Having Jurisdiction as being capable of conducting testing and providing labelling for materials, assemblies and systems that include, but are not limited to, the following organizations:

.1 Underwriters Laboratories of Canada (ULC)

.2 Underwriters Laboratories Inc. (UL)

.3 Warnock Hersey (WH) and Electrical Testing Labs (ETL) Listed

.4 ETL, UL and WH labelling will only be acceptable subject to the following conditions:

.1 Fire resistance rated assemblies and materials bearing an Underwriters Laboratories Inc. (UL) or Warnock Hersey (WH) label will be acceptable for use on this project provided that the label indicates acceptance under Underwriters Laboratories of Canada (ULC) and having one of the following cUL, cULus, cWH or cWHus markings.

.2 Materials that only have UL, ULus, WH or WHus markings are not acceptable.

.5 Examples of acceptable marks from Recognized Testing Authorities:

.7 Standard Details: Details prepared by the Departmental Representative indicating an assembly based on generic materials demonstrating configuration and proposed methods for attaining the required fire rating; Standard Details may be derived from the following criteria:

.1 Details may be based on specific Rated Systems provided by a Recognized Testing Authority.

.2 Details may be based on time assigned to materials listed in the Building Code.

.3 Details are of a general nature only, sufficient to inform the bidders of the Departmental Representative's design intent, and do not portray every instance or requirement that can be represented on the Project site; the supplier of materials is responsible submitting design information for firestopping and smokeseal systems required for the Project to the Departmental Representative prior to starting work.

1.4 REFERENCE STANDARDS

.1 Intertek Group:

.1 Directory of WH Listed Building Products

.2 Directory of ETL Listed Electrical and Electronic Products

.2 International Firestop Council (IFC):

.1 Guidelines for Evaluating Firestop Systems Engineering Judgments

.3 Underwriters Laboratories of Canada (ULC):

.1 Directory of Burglar and Fire Alarm Systems and Components

.2 Directory of Building Materials

.3 Directory of Fire Protection Equipment

.4 Directory of Fire Resistance

.5 Directory of Firestop Systems and Components

.6 Directory of Heating and Ventilating Equipment, Flammable Liquids and Gases Equipment, and Marine Equipment

.4 Underwriters Laboratories Inc. (UL):

.1 UL Fire Resistive Assemblies and Systems, Certified for Canada.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Delegated Design: Design fire resistive assemblies, firestopping and smokeseals required by the Contract Documents to withstand fire ratings indicated on Drawings and in accordance with requirements of the Building Code:

.1 Provide manufacturers standard details where site conditions match standard assembly listings.

.2 Provide manufacturers Engineered Judgment, indicating acceptance by the Authority Having Jurisdiction, signed by manufacturer's CFPS designer, where assembly does not match standard assembly listing.

.3 Confirm proposed rated system materials and methods to applicable codes and ordinances of the Authority Having Jurisdiction.

.4 Additional performance requirements are listed in the referenced technical specification sections.

.2 Coordination: Subcontractor is required to notify the Contractor where their work passes through a fire separation or removes any fire resistive materials, so that the penetration or damage is filled or repaired by an acceptable installation contractor to maintain the integrity of the fire separations:

.1 Contractor is required to notify the Departmental Representative prior to penetrating any load bearing assembly that does not have a predetermined penetration location; Rated Systems do not re-establish the structural integrity of load bearing partitions or assemblies, or support live loads and traffic.

.2 Rated System can be either "built-in" (such as; integral with concrete placement) or "post-installed"; provide built-in Rated System devices prior to concrete placement or masonry installation.

.3 Coordinate construction of openings and penetrating items and verify that through Rated Systems are installed according to specified requirements.

.4 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetrations through fire and smoke rated separations.

.3 Preinstallation Conference: Conduct conference at Project site in accordance with the requirements of Section 01 31 19 to discuss proposed Rated Systems supplied by the installing Subcontractor and manufacturer, modifications to the Departmental Representative's Standard Details, Engineered Judgements, placement of identification labels and coordination issues, and as follows:

.1 Attendees for meetings include the Departmental Representative, Contractor, installing Subcontractor's, Manufacturer's Authorized Representative(s), and the Owner's third party inspection agency; the Authority Having Jurisdiction can be invited as a courtesy, but it is not mandatory that they attend the meeting.

.4 Scheduling: Schedule required site visits, submission requirements and documentation procedures, review of Mock-Ups (if any) and inspection of fire and smoke rated assemblies as follows:

.1 Authority Having Jurisdiction: Notify Authority Having Jurisdiction in sufficient time to allow for inspection prior to Rated Systems being covered up or enclosed.

.2 Owners Testing Agency: Inspection and Testing: Coordinate with Owner's third party inspection agency and incorporate any corrections or modifications required by inspection agency.

.5 Sequencing: Sequence installation of fire and smoke rated components to maintain the continuity of fire separations whether or not shown on the drawings:

.1 Fire separations may not be pierced by electrical or similar service outlets except in accordance with Building Code.

.2 Do not support non-combustible construction on combustible construction.

.3 Firestop openings in non-combustible construction that terminates at the exterior wall, the underside of floor, ceiling, or roof structures, and at floors with non-combustible materials.

.4 Do not use combustible members, fastenings, and similar items to anchor fixtures to fire separations.

.5 Firestop openings for non-combustible pipes and ducts to prevent the passage of smoke and flame.

.6 Existing fire separations must be maintained as such; any cutting must be sealed to retain the separation's integrity.

1.6 QUALITY ASSURANCE

.1 Rated Systems specified for the Project will be supplied and installed by a Subcontractor specializing in the application of specific systems as follows:

.1 Spray Applied Fire Resistive Materials: Specified in Section 07 81 00 for fire rating of structural systems – Single Source Responsibility for Project.

.2 Firestopping and Smokeseals: Specified in Section 07 84 00 for mechanical and electrical penetrations, floor and wall openings, top-of-wall seals, perimeter building seals and re-enterable cable management systems – Single Source Responsibility for Project.

.2 Subcontractors installing Rated Systems must be certified by the Manufacturer to install any named Products, and have a minimum of five (5) years experience in the types of Rated Systems specified for the Project.

.3 Manufacturer's authorized representative (not distributor or agent) will be onsite during initial installation of Rated Systems to train Subcontractor's personnel in proper selection and installation procedures in accordance with manufacturer's written recommendations.

1.7 SUBMITTALS

.1 Submit a summary of Rated Systems proposed for use in the Project within four (4) weeks of starting work of the Contract in accordance with Section 01 33 00, and as follows:

.1 Provide summary of manufacturer's details and Engineered Judgements in a format similar to that attached to the end of this Section

.2 Attach detailed sketches and drawings, manufacturer's written installation instruction, and material safety and data sheets to the summary; fully cross referenced to the Drawings and the summary.

.3 Manufacturer's Details:

.1 Submit manufacturer's details indicating an assembly or system that matches the design intent provided by the Standard Details.

.2 Manufacturer's standard details must be signed by CFPS, and include only content that is applicable to the Work of the Project.

.3 Provide additional details as required to address additional detail conditions not covered by the Standard Details.

.4 Engineered Judgements:

.1 Manufacturer's details indicating a modification to an assembly or system required to meet the design intent provided by the Standard Details or to address a specific site condition not normally test for in the manufacturer's testing program.

.2 Engineered Judgments must include project name and Subcontractor's name who will install Rated System described in the Engineered Judgement.

.3 Engineered Judgements must be signed by a CFPS employed by the manufacturer, and who was directly responsible for preparation of the Engineered Judgement.

.4 Prepare Engineered Judgements in accordance with IFC Guidelines for Evaluating Firestop Systems Engineering Judgements.

.2 Letters of General Conformance:

.1 Provide letters of General Conformance as required by Section 01 33 50.

.2 A principal of the installing company and the Manufacturer's Authorized Representative (CFPS) jointly sign required letters instead of a professional engineer as required by Section 01 33 50.

.3 Submit additional letters of General Conformance where there are more than one Manufacturer's Authorized Representative or installing Subcontractors.

.3 Samples: Submit samples of each type of firestopping, smokeseal and accessory to the Departmental Representative prior to starting work.

1.8 MOCK-UP

.1 Provide Mock-Up in an accessible location at the Project site ready for review by the Authority Having Jurisdiction and the Departmental Representative in accordance with Section 01 45 00 – Quality Control.

.2 Mock-Up will be representative of the Rated Systems used for the Project, and be kept in a location that can be referenced during the entire construction period; Mock-Up will form the basis for acceptance of installed systems by the Authority Having Jurisdiction and the Departmental Representative.

.3 Refer to individual technical specification sections, which may provide additional requirements for Mock-Ups.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Fire Test Response Characteristics: Provide Rated Systems identical to those tested in assembly indicated by the Recognized Testing Authority; provide Engineered Judgements for systems that do not match the Rated Systems:

.1 Provide a label and proof of fire resistive materials used in Rated Systems issued by a Recognized Testing Authority.

.2 Refer to technical sections for specific requirements for sealing penetrations and joints of smoke and fire separations.

2.2 MATERIALS

.1 Provide Rated Systems composed of components that are compatible with each other, the substrates they are applied to, and the items (if any) penetrating the Rated System under conditions of service and application as demonstrated by the manufacturer based on testing and site experience.

.2 Provide complete components for each Rated System that are needed to properly install material forming the system; use only components specified by the manufacturer and approved by the Recognized Testing Agency for the designated fire resistance rated systems.

2.3 IDENTIFICATION MATERIALS

.1 Adhesive Labels: Nominal 75 mm high x 125 mm wide self adhering labels placed adjacent to fire and smoke rated penetration components, printed with the following information:

.1 ATTENTION: FIRE RATED PENETRATION ASSEMBLY
DO NOT MODIFY

HOUR RATING AND CLASS OF PENETRATION ASSEMBLY

.2 Name of firestopping manufacturer;

.3 Names of products used;

.4 Manufacturers standard detail number, or Engineered Judgement identifier; ULC or cULus Number;

.5 Date of installation;

.6 Name of installing Subcontractor;

.7 Contact telephone number for repair or replacement of firestopping materials.

.8 Size of Label

.9 Placement: Place self adhering labels on a permanent surface adjacent to firestopping or smokeseal installation in an inconspicuous location in fully finished areas and as follows:

.1 Acceptable locations include areas such as within concealed ceiling spaces, above cable trays, out of direct line-of-sight beside penetrations and similar locations.

.2 Confirm locations before final placement.

.10 Example:

.2 Stencil Signs: Nominal 300 mm high by 400 mm wide painted and stencilled permanent signage applied to fire walls, fire barriers and partitions, smoke barriers and partitions and other wall or floor assemblies containing protected openings and penetrations labelled with the following information:

.1 ATTENTION: FIRE RATED BARRIER – PROTECT ALL OPENINGS

HOUR RATING OF ASSEMBLY
OR (as appropriate to installation)

ATTENTION: SMOKE RATED BARRIER – PROTECT ALL OPENINGS

.2 Placement: Apply stencilled signage to wall or barrier surface at 10 metre intervals, evenly laid out across the length of the assembly at a concealed locations and as follows:

.1 Acceptable locations include areas such as above finished ceilings, or out of direct line-of-sight in finished public spaces.

.2 Acceptable exposed locations include areas such as within unoccupied spaces, mechanical and electrical rooms and similar unfinished non-public spaces.

.3 Confirm locations before final placement.

.3 Self adhering labels containing similar information and sized similarly to site stencilled signage are considered as an acceptable substitution for stencilled and painted signage.

.4 Example:

Part 3 Execution

3.1 RESPONSIBILITIES OF PARTIES INVOLVED

.1 The Departmental Representative is responsible for the following:

.1 Provide Standard Details of Rated Systems for the guidance of the Contractor, Subcontractors, and Authority Having Jurisdiction; Standard Details represent design intent only, and do not portray every condition that may arise in the construction process.

.2 Review manufacturer's submittals for conformance to design intent to comply with the Departmental Representative's requirements for completing schedules required by the Building Code.

.2 The Contractor is responsible for the following:

.1 Direct Subcontractors responsible for installation of Rated Systems to submit a summary of Rated Systems used in the project for submission to the Authority Having Jurisdiction and the Departmental Representative.

.2 Direct Subcontractors responsible for installation of Rated Systems to complete any Mock-Ups required by the technical specification sections ready for review by the Authority Having Jurisdiction and the Departmental Representative.

.3 Direct the Subcontractor to submit Letters of General Conformance to the Departmental Representative.

.4 Direct the Subcontractor to notify the Authority Having Jurisdiction to inspect installed Rated Systems.

.3 The Authority Having Jurisdiction will be responsible for the following:

.1 Review manufacturer's submittals for compliance with local codes and ordinances.

.2 Review Mock-Ups (if any) for compliance with local codes and ordinances.

.3 Review of installed Rated Systems for compliance with local codes and ordinances.

3.2 SITE REVIEW

.1 Notify Departmental Representative a minimum of seven days in advance of completion of installation of fire and smoke rated systems and firestop installations; confirm dates and times on days preceding each series of installations.

.2 Do not cover up fire and smoke rated construction or firestop systems that will become concealed behind other construction until Departmental Representative has reviewed and Authority Having Jurisdiction's building inspector have examined each installation.

.3 Cut tests may be made at random; the Departmental Representative will determine the frequency of cut tests, but will not be more than 1% of total length of firestopping and smokeseals:

.1 Make all necessary repairs and correct all deficiencies noted after completion of cut tests.

3.3 SITE QUALITY CONTROL

.1 Owner will retain a qualified third party inspection agency to conduct site review of fire and smoke rated construction to verify that fire and smoke rated assemblies, firestopping and smokeseals have been installed in accordance with governing regulations, requirements of the manufacturer and to meet acceptance criteria of the Authorities Having Jurisdiction.

.2 Third party inspection agency will be responsible for the following:

.1 Review Contract Documents and verify Code requirements.

.2 Attend pre--construction meetings.

.3 Review submittals of drawings, assemblies and samples.

.4 Review mock-ups and provide input into mock-up requirements.

.5 Perform periodic site reviews and provide reports.

.6 Perform thickness and density testing and provide reports.

.7 Upon project completion provide a letter of certification indicating that code requirements have been met.

.3 Owner's provision of a third party inspection agency does not relieve Contractor of responsibility for supply and installation of conforming fire and smoke rated separations and assemblies.

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3.4 SAMPLE SUMMARY FORM

.1 The following Sample Summary Form can be used to develop the listing of Rated Systems required for the Project as noted in Item 1.7.1 above:

RATED SYSTEM SUMMARY SHEET			
Project Name:			Date:
Project Address:			
Installing Subcontractor:			Telephone:
Installer's Address:			
Submitted to: **DIALOG**®			
SPRAY APPLIED FIRE RESISTIVE MATERIALS			
Type of Assembly: Wall, Floor, Roof or Ceiling	Combustible or Non-Combustible Assembly	Rating: Time, Restraint or Unrestrained	Design or Listing Number
INTUMESCENT FIRE RESISTIVE MATERIALS			
Type of Assembly: Wall, Floor, Roof or Ceiling	Combustible or Non-Combustible Assembly	Rating: Time, Restraint or Unrestrained	Design or Listing Number

RATED SYSTEM SUMMARY SHEET			
Project Name:			Date:
Project Address:			
Installing Subcontractor:			Telephone:
Installer's Address:			
Submitted to: **DIALOG®**			
CONCRETE FIRE PENETRATIONS – HORIZONTAL OR VERTICAL (FT RATING)			
Type of Penetration	**Combustible or Non-Combustible Penetrating Material**	**FT Rating**	**Design or Listing Number**
Water Distribution			
Sprinkler Piping			
Drain Waste and Vent (DWV) Piping			
Gas Piping			
HVAC Ducts (Not requiring Dampers)			
Electrical Cables (Diameter >25 mm)			
Electrical Metallic Tubing (EMT) or Steel Conduit.			
Other Penetrations			

RATED SYSTEM SUMMARY SHEET			
Project Name:			Date:
Project Address:			
Installing Subcontractor:			Telephone:
Installer's Address:			
Submitted to: **DIALOG**®			
PENETRATIONS THROUGH FLOOR ASSEMBLIES			
Type of Penetration	Combustible or Non-Combustible Penetrating Material	F Rating	Design or Listing Number
Water Distribution			
Sprinkler Piping			
Drain Waste and Vent (DWV) Piping			
Gas Piping			
HVAC Ducts (Not requiring Dampers)			
Electrical Cables (Diameter >25 mm)			
Electrical Metallic Tubing (EMT) or Steel Conduit.			
Other Penetrations			

RATED SYSTEM SUMMARY SHEET			
Project Name:			Date:
Project Address:			
Installing Subcontractor:			Telephone:
Installer's Address:			
Submitted to: **DIALOG**®			
PENETRATIONS THROUGH WALL ASSEMBLIES			
Type of Penetration	Combustible or Non-Combustible Penetrating Material	F Rating	Design or Listing Number
Water Distribution			
Sprinkler Piping			
Drain Waste and Vent (DWV) Piping			
Gas Piping			
HVAC Ducts (Not requiring Dampers)			
Electrical Cables (Diameter >25 mm)			
Electrical Metallic Tubing (EMT) or Steel Conduit.			
Other Penetrations			
PERIMETER SEALS, TOP-OF-WALL DETAILS AND OTHER FIRESTOPPING			
Type of Penetration	Combustible or Non-Combustible Material	FT or F Rating	Design or Listing Number

RATED SYSTEM SUMMARY SHEET			
Project Name:			Date:
Project Address:			
Installing Subcontractor:			Telephone:
Installer's Address:			
Submitted to: **DIALOG**®			

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 22 00 - Concrete Unit Masonry

.2 Section 05 50 00 – Metal Fabrications: Supplementary support systems and anchors for attachment of fabricated wall panel assemblies to building structure.

.3 Section 07 25 19 – Sprayed Foam Air and Vapour Seals: Sealing around penetrations through work of this Section.

.4 Section 07 52 00 – Modified Bituminous Membrane Roofing: Transition membranes and flashing components to adjacent roof construction.

.5 Section 07 62 00 – Sheet Metal Flashing and Trim: Metal flashing and trim, rainwater gutters and leaders not forming part work of this Section.

.6 Section 07 92 00 – Joint Sealants: Site applied sealants.

1.2 DEFINITIONS

.1 Minimum Uncoated Steel Thickness: Minimum uncoated thickness of lightweight steel framing shall be not less than 95% of the thickness used in the design for the framing system:

.1 Lesser thicknesses may be permitted at bends arising from the cold forming process.

.2 Metal thicknesses listed in this section are minimum uncoated steel thickness; exclusive of any subsequent coatings or treatments.

.2 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the Consultant.

.3 Commitment to General Reviews by Architects and Engineers and Letter of General Conformance: Documents prepared by the delegated design professional engineer as recommended by PEO guidelines for providing general review of construction by the professional engineer

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 ASTM A755/A755M-03 (2008), Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil Coating Process for Exterior Exposed Building Products

.3 ASTM A792/A792M-09, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

.4 ASTM E72-05, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction

.5 ASTM E283-04, Standard Test Method for Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen

.6 ASTM E331-00 (2009) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.2 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 20M-99, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications

.2 CSSBI S8-2007 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products

.3 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials

.2 CAN/ULC S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.3 CAN/ULC S134-92, Standard Method of Fire Test of Exterior Wall Assemblies

.4 CAN/ULC S705.1-01, Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density-Material-Specification

.5 CAN/ULC S705.2-01, Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density-Material-Application

.6 CAN/ULC S770-03, Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate work of this Section with work of other sections that may have items supported by or built into fabricated wall panel assemblies and as follows:

.1 Flashings for Other Work of the Contract: Coordinate work of this section with requirements of Section 07 62 00 for supply of prefinished sheet metal flashing materials to other Sections of the Work with installation by other Sections of the Work as follows:

.1 Supply prefinished sheet metal flashings required for the project in sheet metal thickness and colour specified in this Section.

.2 Provide prefinished sheet metal flashings tension levelled and guillotine sheared to length ready for brake forming, fabrication and installation.

.2 Pre-Construction Meetings: Include required participants and an outline agenda for meeting in accordance with Section 01 31 19 – Project Meetings and as follows:

.1 Meeting Time: Arrange meeting before starting work k this Section to discuss expectations for fit and finish of fabricated wall panel assemblies, quality of workmanship for installation of air and vapour retarders and transitions, continuity of insulation and relationship of wall system to adjacent components.

1.5 SUBMITTALS

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

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product specifications, standard details, certified product test results, and general recommendations as applicable to materials and finishes for each component and for total panel assemblies.

.2 Shop Drawings: Submit shop drawings indicating layouts of panels, details of corner conditions, joints, panel profiles, supports, anchorages, trim, flashings, closures, and special details, distinguishing between prefabricated and site assembled work.

.3 Samples for Verification: Submit two (2) - 300 mm x 300 mm samples representing specified profile, colour and texture, and other exposed panel accessories for verification and acceptance by the Departmental Representative.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Source Quality Control Submittals: Submit design notes and calculations signed and sealed by professional engineer indicating compliance with design criteria for work of this Section.

.2 Delegated Design Submittals: Submit Letters of Commitment and Compliance indicating that structural analysis for installed products are in accordance with design loadings and requirements of this Section.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:

.1 Manufacturer: Use a manufacturer that has completed wall panel assemblies having similar extent and complexity as required for the Work of this Contract.

.2 Installers: Use experienced installers having experience with panel projects similar in material, design and extent as required for Work of this Contract with a record of successful in-service performance.

.3 Delegated Design Professional Engineer: Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including; but not limited to, the following:

.1 Seal and signature to shop drawings and design submittals

.2 Site review and certification of installed components

.3 Completion of Letters of Commitment and Compliance specified in Section 01 33 50.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials so they will not be damaged or deformed; packaged to protect against damage during transportation.

.2 Storage and Handling Requirements: Handle materials during unloading, storing, and erecting to prevent bending, warping, twisting, and surface damage, and as follows:

.1 Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering to maintain wall system in a dry condition and prevent watermarking of panel finishes.

.2 Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

1.8 SITE CONDITIONS

.1 Site Measurements: Verify locations of structural members and opening dimensions by site measurements before fabrication and indicate measurements on shop drawings for fabricated wall panel assemblies that are indicated to fit other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating wall panel assemblies without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Design fabricated wall panel assemblies to meet or exceed the following minimum requirements:

.1 Structural Performance: Design panel composition and fastening requirements in accordance with ASTM E72 based on the following deflection criteria:

.1 Live Loads: Determine live load deflections in accordance with CSSBI 20M, as modified by the requirements of this Section

.2 Wind Load: Determine wind loads using normal importance factors listed in the Building Code for deflection and strength, modified by the appropriate exposure, gust and pressure (internal and external) factors in accordance with Building Code structural commentaries

.3 Deflection Limitation: L/180 based on maximum allowable deflection under 1 in 50 year sustained wind loading

.4 Fatigue: Withstand 2 million alternate cycles of specified deflection limitation with no delamination of face skins from core, foam core cracking or permanent deformation

.5 Movement: Allow for movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subjected to seasonal surface temperatures ranging from -35°C to +50°C, and to accommodate movement between wall system and building structure by deflection of building structure.

.2 Air and Moisture Performance: Design panel joints to resist and control air and rainwater penetration using pressure equalization and rain screen technique to the following maximum limits:

.1 Air Infiltration: Maximum 0.3 L/m² of wall area at 0.95 kPa pressure differential in accordance with ASTM E283

.2 Water Penetration: Zero uncontrolled water penetration at 0.95 kPa pressure differential in accordance with ASTM E331

.3 Provide for positive drainage to the exterior of all water entering or condensation occurring within the system.

.3 Thermal Performance: Design wall thickness of fabricated wall panels using nominal long term thermal resistance of RSI 1.15 per 25 mm of polyurethane thickness in accordance with CAN/ULC S770.

2.2 MATERIALS

.1 Zinc Galvanized Sheet Steel: Tension levelled, Commercial Steel (CS) designation, Type A, Grade 230 in accordance with ASTM A653/A653M and as follows:

.1 Thickness: Provide sheet steel in the following base metal thickness, or thicker as required to meet design loads:

.1 Liner Sheet: Minimum 0.46 mm

.2 Exterior Sheet: Minimum 0.61 mm

.2 Galvanizing Designation: Z275 applied evenly to both sides

.3 Profile:

.1 Liner Sheet: Stucco Embossed

.2 Exterior Sheet: Micro Ribbed

.4 Finish: Prefinished materials coated to film thickness as recommended by coating manufacturer, and designed specifically for vertical surfaces to 30° from vertical, and horizontal surfaces 5° up to 60° from horizontal and in accordance with ASTM A755 and as follows:

.1 Interior Finish: Manufacturer's standard white

.2 Exterior Finish: Manufacturer's standard black.

.2 Core Material: Foamed in place multi-component Polyisocyanurate or Polyurethane insulation; blown using Montreal Protocol compliant agents having zero ozone depletion potential and having the following physical properties based on CAN/ULC S705.1 and CAN/ULC S705.2:

.1 Closed Cell Composition: Nominal 95%

.2 Density: Nominal 35 to 45 kg/m³

.3 Compressive Strength: Nominal 210 kPa

.3 Accessories: Manufacturer's standard materials as required for a complete and functional installation including; but not limited to, the following:

.1 Flashings, Enclosures and Trims: Matching colour and thickness of exterior sheet, coordinate requirements with Section 07 62 00

.2 Fasteners: Concealed type; in joint hex or pan headed fasteners

.3 Washers: Concealed type; weather tight

.4 Liquid Sealants: Non-curing, pressure resistant type; for use within internal panel joints, coordinate requirements with Section 07 92 00

.5 Preformed Sealants: Preformed silicone sheets; for use in transition joints between wall panels and adjacent construction, coordinate requirements with Section 07 92 00

2.3 FABRICATION

.1 Fabricate panels to thickness required by insulation value indicated on Drawings.

.2 Fabricate panels from roll formed steel face and liner sheets chemically fused to a foamed in place rigid polyurethane expanded foam core as a single piece construction full height or stacked in multiple courses to suit design requirements for Work of the Contract.

.3 Fabricate longitudinal edges of panel with roll formed male and female interlocking geometry fully supported by foamed in place insulation core with insulation core moulded into tongue and groove joint to allow positive insulation-to-insulation contact between panels to provide continuous thermal enclosure.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that support structures are aligned and tolerances are within requirements provided during preconstruction meeting; starting work of this Section denotes acceptance of conditions.

3.2 INSTALLATION

.1 Install panels, clips, fasteners, joint enclosures and trims, flashings and related sealants in accordance with manufacturer’s written instructions.

.2 Install panels to match plane of framing and other construction as required to meet installed panel tolerances; with final installation having straight, sharply formed edges.

.3 Install panels with uniform joint width, aligned vertically and horizontally; include control joints installed as required to account for panel movement resulting from deflection of structure or temperature changes.

.4 Install flashings to divert all moisture and condensation to exterior; trim and flash around doors, louvers, windows and other openings or penetrations through the panel assembly.

3.3 SITE QUALITY CONTROL

.1 Conduct final review and acceptance of completed work of this Section with the Departmental Representative; compile a list of corrections or modifications required and submit certification indicating that installation is in general conformance with manufacturer’s installation requirements.

3.4 CLOSEOUT ACTIVITIES

.1 Damaged Materials: Repair or replace damaged materials as directed by Departmental Representative; cost of repairs or replacement will be assessed to responsible parties.

.2 Cleaning: Strip protective films, clean surfaces and remove any substances such as metal fillings caused by drilling that could cause discolouration of staining; remove excess materials, debris and equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.2 ASTM D41/D41-11, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-56M-80(1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.3 Canadian Roofing Contractors Association (CRCA)

.1 CRCA Roofing Specifications Manual-1997.

.4 Canadian Standards Association (CSA International)

.1 CSA A123.21-10, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems

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

.3 CSA O151-09, (R2014) Canadian Softwood Plywood.

.5 Factory Mutual (FM Global)

.1 FM Approvals - Roofing Products.

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

.1 Material Safety Data Sheets (MSDS).

.7 Underwriters Laboratories' of Canada (ULC)

.1 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with roofing contractor's representative and Departmental Representative in accordance with Section 01 31 19 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 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS, and indicate VOC content for:

.1 Primers.

.2 Asphalt.

.3 Sealers.

.4 Filter fabric.

.3 Provide shop drawings:

.1 Indicate flashing, tapered insulation details.

.2 Provide layout for tapered insulation.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of membrane with specification requirements.

.6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.7 Manufacturer's field report: in accordance with Section 01 45 00.

.8 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.4 QUALITY ASSURANCE

.1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years experience and approved by manufacturer.

.2 Perform roofing and sheet metal work in conformance with the roofing manufacturer's written recommendations using materials that meet the requirements of CAN/ULC S107 to obtain a Class C fire resistance rating and CSA A123.21-10; submit proof that roofing materials meet required performance when requested by the Departmental Represenative.

.3 Conform to Roofing Specifications as published by Canadian Roofing Contractors Association (CRCA) as a reference.

.4 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years experience.

.5 Installer must maintain a full time experienced journeyman roofer, and at least one apprentice per crew on the Work at all times and as follows:

.1 The roofing Subcontractor and his sub-subcontractors must have “Approved Contractor” status by the roofing product manufacturer. Only skilled and certified trade persons, officially employed by a roofing Subcontractor operating adequate and necessary equipment, must be authorized to perform all roofing work.

.2 Crew members using torches must be trained under a recognized training program and certified from the manufacturer of materials being installed. Only competent, qualified tradesmen, using adequate plant and equipment, must execute the Work of this Section.

1.5 FIRE PROTECTION

.1 Do not apply torch directly to dry or unprotected wood surfaces.

.2 Maintain a clean site and have one approved ABC fire extinguisher within 6 meters of each roofing torch. Respect all safety measures described in manufacturer’s technical data sheets. Do not place torches near combustible or flammable products.

.3 Maintain fire watch for 3 hours after each day's roofing operations cease.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00.

.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 felt and membrane in upright position. Store membrane rolls with salvage edge up.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5 degrees C minimum.

.7 Store insulation protected from daylight and weather and deleterious materials.

1.7 FIELD CONDITIONS

.1 Ambient Conditions

.1 Do not install roofing when temperature remains below -18°C for torch application.

.2 Minimum temperature for solvent-based adhesive is -5 degrees C.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.8 WARRANTY

.1 For Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing, 12 months warranty period is extended to 120 months.

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, Gypsum Board: to ASTM C1177/C1177M, 13mm thick.

2.3 VAPOUR RETARDER

.1 Self adhesive air/vapour barrier modified bitumen membrane.

2.4 PERIMETER FIRE SEAL

.1 SBS modified bitumen, minimum 60 gm/m2 glass fleece reinforced, self adhering membrane having sanded top face, cut into strips minimum 150 mm wide x nominal 1.5 mm thick.

2.5 MEMBRANE

.1 Base sheet: to CGSB 37-GP-56M.

- .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, polyester reinforcement, having nominal weight of 180 g/m^2.
- .2 Type 2, fully adhered.
- .3 Class C - plain surfaced.
- .4 Grade 1 - standard service.
- .5 Top and bottom surfaces:
  - .1 Sanded/polyethylene.
- .6 Base sheet membrane properties: to CGSB 37-GP-56M.
  - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
  - .2 Breaking strength (longitudinal/transversal): 17.0/12.5 N/5 cm.
  - .3 Ultimate elongation (longitudinal/transversal): 60/65%.
  - .4 Tear resistance: 60 N.
  - .5 Cold bending at -30°C: no cracking.
  - .6 Softening point: ≥ 110°C.
  - .7 Static puncture resistance: 400.
  - .8 Dimensional Stability: -0.3/0.3 %.

.2 Cap sheet membrane: to CGSB 37-GP-56M.

- .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, glass reinforcement, having nominal weight of 250 g/m^2.
- .2 Type 1, fully adhered.

.3 Class A-granule surfaced.

.1 Colour for granular surface: gray.

.4 Grade 2 -heavy duty service.

.5 Bottom surface polyethylene.

.6 Cap sheet membrane properties: to CGSB 37-GP-56M.

.1 Strain energy (longitudinal/transversal): 10 /10 kN/m.

.2 Breaking strength (longitudinal/transversal): 17/16 kN/m.

.3 Ultimate elongation (longitudinal/transversal): 60/65 %.

.4 Tear resistance: 420 N.

.5 Cold bending at -30°C: No cracking.

.6 Softening point: ≥ 105°C.

.7 Static puncture resistance: ≥ 420.

.8 Dimensional Stability: 0.8/0.2 %.

.7 ULC certification: Class C.

2.6 ADHESIVE

.1 Adhesive for securing overlay board and insulation: asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive.

.2 Gypsum Board Adhesive: Manufacturers standard adhesives specifically formulated for installation of gypsum board to metal deck

2.7 OVERLAY BOARD

.1 Overlay Board: 6 mm thick asphalt based recovery board with non-woven glass facers, as recommended by the membrane manufacturer.

.1 Install over insulation to provide torch safe surface.

2.8 POLYISOCYANURATE INSULATION

.1 Primary Flat and Sloped Insulation: To CAN/ULC-S704, Type 3, organic glass mat facer, flame spread classification: less than 500, thickness as indicated.

.1 Provide custom fabricated sloped roof insulation system and roof drain sumps.

2.9 SEALERS

.1 Plastic cement: asphalt.

.2 Sealing compound: Multi-purpose mastic composed of SBS modified bitumen, fibres, mineral fillers and solvents, rubber asphalt type as recommended by the membrane manufacturer.

.3 Liquid Flashing: Bitumen/polyurethane waterproofing mono-component resin and polyester reinforcement; type recommended by the membrane manufacturer.

.4 Sealants: Caulking - see Section 07 92 00.

2.10 CARPENTRY

.1 Refer to Section 06 08 99.

2.11 CANT STRIPS

.1 Cut from prefabricated rigid mineral wool fibre material, to measure 140 mm on slope.

2.12 FASTENERS

.1 Covering to steel deck: No. 10 flat head, self tapping, Type A or AB, cadmium plated screws; Recommend FM Approved screw and plate assemblies

.2 Roofing nails: Spiral nails with steel round-top cap 25 mm in diameter and 3 mm diameter shank, length to penetrate solid wood supports by at least 38 mm and plywood substrates by at least 19 mm.

Part 3 EXECUTION

3.1 QUALITY OF WORK

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual, particularly for fire safety precautions, and to CSA A123.21 standard.

.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 sheet metal and 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.

.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, roofs and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 DECK SHEATHING

.1 Screw gypsum board levelling surface into the upper rib surfaces at a minimum rate of one (1) fastener per 0.25 m², 12 screws and washers for each 1220 mm x 2440 mm board.

.2 Increase rate to one (1) fastener per 0.20 m², 15 screws and washers for each 1220 mm x 2440 mm board, for a distance of 2440 mm around the perimeter of the roof and 45° across the corners at a distance of 3050 mm from the corner of the building.

.3 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

3.5 PRIMING DECK

.1 Apply deck primer to gypsum board roofing substrate at the rate recommended by manufacturer.

3.6 VAPOUR RETARDER (STEEL DECK)

.1 Adhere vapour retarder as per manufacturer's instructions.

3.7 VAPOUR RETARDER (CONCRETE/GYPSUM BOARD/PLYWOOD DECK)

.1 Modified bituminous vapour retarder sheet.

3.8 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING APPLICATION

.1 Insulation: fully adhered, adhesive application:

- .1 Adhere insulation to laminated vapour barrier using solvent-based 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.
- .5 Separate the membrane and insulation with a drainage layer or slipsheet.

.2 Tapered insulation application:

.1 Adhere insulation to vapour retarder and top layer of insulation to bottom layer.

.2 Install tapered insulation in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

.3 Overlay Board: adhesive application:

.1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre per m^2.

.2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.

.3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.

.4 Base sheet application:

.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Application to be free of blisters, wrinkles and fishmouths.

.5 Cap sheet application:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

.4 Application to be free of blisters, fishmouths and wrinkles.

.5 Do membrane application in accordance with manufacturer's recommendations.

.6 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Torch base and cap sheet onto substrate in 1 metre wide strips.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.5 Provide 75 mm minimum side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.7 Do work in accordance with manufacturer's recommendations.

.7 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.

3.9 CANTS

.1 Install prefabricated mineral wool fibre cants over rigid insulation.

.2 Apply adhesive to receiving surface and embed cant firmly by hand.

.3 Angle cut cants to fit tightly on back and bottom where roof to wall angle varies from 90 degrees.

3.10 FIELD QUALITY CONTROL

.1 Inspections:

.1 Inspection and testing of roofing application will be carried out by testing laboratory designated by Departmental Representative.

.2 Departmental Representative will pay for tests as specified in Section 01 45 00.

3.11 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 20.

.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 Unused coating material must be disposed of at official hazardous material collections site as reviewed by Departmental Representative.

.5 Unused adhesive, sealant and membrane 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.

.6 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

.7 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.

.8 Dispose of unused membrane at official hazardous material collections site approved by Departmental Representative.

.9 Divert unused gypsum materials from landfill to recycling facility as reviewed by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM D523-14, Standard Test Method for Specular Gloss.

.3 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.2 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual 2012.

.3 Canadian Standards Association (CSA International)

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

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

.1 Material Safety Data Sheets (MSDS).

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule #1168-05, Adhesives and Sealants.

1.2 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.

.3 Shop Drawings:

.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.4 Samples:

.1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

.5 Quality assurance submittals: submit following in accordance with Section 01 45 00.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and repair instructions.

.2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

1.3 QUALITY ASSURANCE

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative in accordance with Section 01 32 16 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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Waste Management and Disposal: Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: 0.45 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

2.2 PREFINISHED STEEL SHEET

.1 Prefinished steel with factory applied silicone modified polyester.

.1 Class F1S.

.2 Colour selected by Departmental Representative from manufacturer's standard range.

.3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523.

.4 Coating thickness: not less than 25 micrometres.

.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822/D822M as follows:

.1 Outdoor exposure period 1000 hours.

.2 Humidity resistance exposure period 1000 hours.

2.3 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB-37.5.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.3 Underlay for metal flashing: asphalt laminated 3.6 to 4.5 kg kraft paper.

.4 Sealants: as specified in Section 07 92 00.

.5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

.6 Fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Solder: to ASTM B32, alloy composition.

.9 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.

.10 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work as indicated.

.2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.

.3 Form pieces in 2400 mm maximum lengths.

.1 Make allowance for expansion at joints.

.4 Hem exposed edges on underside 12 mm.

.1 Mitre and seal corners with sealant.

.5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles indicated of 0.45 mm thick galvanized prefinished.

2.6 REGLETS AND CAP FLASHINGS

.1 Form surface mounted metal cap flashing of 0.60 mm thick for base flashings as detailed in accordance with CRCA FL series details.

.1 Provide slotted fixing holes and steel/plastic washer fasteners.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install sheet metal work in accordance with CRCA FL series details, AAI-Aluminum Sheet Metal Work in Building Construction and as detailed.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal.

.1 Secure in place and lap joints 100 mm.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.

.1 Flash joints using S-lock standing seams forming tight fit over hook strips, as detailed.

.5 Lock end joints and caulk with sealant.

.6 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

.7 Caulk flashing at cap flashing with sealant.

.8 Install pans, where shown around items projecting through roof membrane.

3.3 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.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.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 RELATED REQUIREMENTS

.1 Section 05 12 23 – Structural Steel For Buildings: Coordination with application schedule of intumescent fireproofing and structural steel installation.

.2 Section 07 05 53 – Fire and Smoke Assembly Design Requirements and Identification: Coordination of fire rating systems, and design and submittal requirements.

.3 Section 07 84 00 – Firestopping

1.2 REFERENCE STANDARDS

.1 Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):

.1 Coating Materials Guidelines

.2 Surface Preparation Guidelines

.3 SSPC-PA2, Paint Application Specification No.2 - Measurement of Dry Paint Thickness with Magnetic Gages

.2 National Fire Protection Association (NFPA):

.1 NFPA 703-2012, Standard for Fire Retardant-Treated Wood and Fire-Retardant Coatings for Building Materials

.3 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, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.3 CAN/ULC S102.2-10 Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies

.4 ULC List of Equipment and Materials, latest edition

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with Section 05 12 23 so that steel surfaces meet manufacturer's minimum surface preparation requirements for bond surface, free from wax, grease or other deleterious material and that weld flashes are ground smooth ready for work of this Section.

.2 Sequencing: Sequence work in conjunction with installation of structural steel and finishing materials, sprinkler pipes, HVAC systems and other mechanical systems; steel surfaces having less than 900 mm clear working access may necessitate applying materials to inaccessible surfaces prior to erection of the finished steel members, either at the point of fabrication or on-site prior to erection.

1.4 SUBMITTALS

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

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data indicating product characteristics, performance and limitation criteria.

.3 Informational Submittals: Provide the following submittals as work of this Section progresses:

.1 Design Submittals: Design intumescent coating thickness required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as follows:

.1 Provide manufacturers standard listing where site conditions match standard assembly listings.

.2 Provide manufacturers engineered judgment, indicating acceptance by the Authority Having Jurisdiction, signed and sealed by manufacturer's design engineer, where assembly does not match standard assembly listing.

.3 Design thickness of intumescent fire resistant system to provide a fire resistance rating for time period indicated on drawings for columns and beams in accordance with Metric Steel Mass/Heated Perimeter (M/D) calculations.

.2 Certification: Submit written certification indicating performance requirements required by Authorities Having Jurisdiction for listed fire resistance rating.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Products supplied and installed by this section shall be manufactured under testing requirements acceptable to the Authority Having Jurisdiction, and packaged in containers indicating ULC compliance label.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Manufacturer: Company specializing in manufacturing products specified in this section for a minimum of five (5) years.

.2 Applicator: Use applicator that is approved, licensed and supervised by the manufacturer of fire resistant materials; applicator shall have a minimum three (3) years documented experience in work of similar extent and complexity.

.3 Certifications: Provide the following during the course of the Work:

.1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction for required fire resistance rating.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials in original, undamaged, sealed containers with manufacturer's labels and seals intact.

.2 Storage and Handling Requirements: Store materials at manufacturer's recommended temperature in a dry, protected area, elevated off ground, and as follows:

.1 Protect from freezing.

.2 Do not store in direct sunlight.

.3 Check Freeze Watch indicators before accepting delivery of materials.

.4 Discard any materials that have come into contact with contaminants prior to actual use.

1.7 SITE CONDITIONS

.1 Ambient Conditions: Apply intumescent fire resistant materials when temperature of substrate and surrounding air is above manufacturer's minimum temperature requirement accounting for effects of humidity and wind.

Part 2 Products

2.1 INTUMESCENT FIRE RESISTANT MATERIALS

.1 Interior Decorative Steel Coating: Site applied intumescent, thin film, fire resistive coating system meeting design requirements and tested in accordance with CAN/ULC S101, and as follows:

.1 Fire Rating: 2 hours

.2 Primer: Manufacturer's recommended primer for application to steel surfaces exposed to exterior conditions.

.3 Base Coat: Thin film intumescent mastic coating applied in thickness required to meet design fire rating based on steel section properties; requiring no mesh, to provide architecturally smooth finish ready for top coating and having minimum Shore D Hardness of 80.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that materials having a high moisture load that could cause excessive humidity and affect application and drying of intumescent coatings are installed and cured before applying materials of this Section.

.2 Preinstallation Testing: Test surfaces to receive work of this Section and report any defects that may affect the Work of this Section and to confirm compatibility of surfaces to receive fire resistant materials.

3.2 PREPARATION

.1 Protect adjacent surfaces and equipment from over-spray of sprayed materials.

.2 Clean substrate free of dust, dirt, grease or other deleterious materials that could affect bond of fire resistance material to substrates.

.3 Ventilate interior areas during application of work of this Section and 24 hours after application.

1.1.1 Coordinate application of compatible primer to steel prior to shipping to site.

3.3 APPLICATION

.1 Apply intumescent fire resistant in accordance with manufacturer's instructions in sufficient thickness to achieve fire rating indicated; beginning of application means acceptance of substrate.

.2 Apply intumescent fire resistant and decorative finish using airless spray equipment to achieve smooth, high gloss finish; orange peel texture and other surface runs or marks arising from painting operations will require remedial action or replacement.

3.4 SITE QUALITY CONTROL

.1 Departmental Representative will appoint and pay for third party inspection agency in accordance with Section 01 45 00 – Quality Control, to inspect site applied intumescent coatings to:

.1 Verify thickness of intumescent fire resistant material, in accordance with SSPC-PA2 and requirements to achieve fire ratings indicated.

.2 Inspection will be carried out before application of decorative top coat.

3.5 CLOSEOUT ACTIVITIES

.1 Patching: Patch and repair any fire resistant material that has been damaged by this or any other section; coordinate cost of repairs with Contractor; costs for repairs will be assessed to Sections of work responsible for damage.

.2 Cleaning: Remove fire resistant from materials and surfaces not specifically required to be fire rated; remove excess material, over spray, droppings and debris.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

.2 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S101-07, Standard Methods of for 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-S115-11, Standard Method of Fire Tests of Firestop Systems.

1.2 DEFINITIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Continuity of Fire Separations: NBC 2010, Division B, Parts 3.1.8 and 3.1.9.1, 9.10.9):

.1 Wall, partition or floor assemblies required to be a fire separation shall be: constructed as a continuous element; have a fire resistance rating; have openings protected by a closure; and have penetrations sealed by a firestop.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.

.3 Shop Drawings:

.1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details should accurately reflect actual job conditions.

.4 Samples:

.1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.

.5 Quality assurance submittals: submit following in accordance with Section 01 45 00.

.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, cleaning procedures.

.4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company specializing in fire stopping installations with 5 years documented experience and approved by manufacturer.

.2 All fire stopping material shall be from one manufacturer.

.3 All fire stopping installation work for entire project shall be by a single contractor experienced in firestopping. Individual disciplines shall NOT fire stop their own work.

.2 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 32 16 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.

.3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work 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.

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.

.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, ULC markings.

.2 Storage and Protection:

.1 Store materials indoors 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 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Fire stopping and smoke seal systems: in accordance with CAN/ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.

.2 Fire stop system rating: F.

.2 Service penetration assemblies: systems tested to CAN/ULC-S115.

.3 Service penetration fire stop components: certified by test laboratory to CAN/ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 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.

.10 Sealants for vertical joints: non-sagging.

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 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 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 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.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by Departmental Representative.

.2 Install floor fire stopping before interior partition erections.

.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Mechanical pipe insulation: certified fire stop system component.

.1 Ensure pipe insulation installation precedes fire stopping.

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.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.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 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Edge of floor slabs at curtain wall and precast concrete panels.

.3 Top of fire-resistance rated masonry and gypsum board partitions.

.4 Intersection of fire-resistance rated masonry and gypsum board partitions.

.5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.7 Openings and sleeves installed for future use through fire separations.

.8 Around mechanical and electrical assemblies penetrating fire separations.

.9 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials, preparation and application for caulking and sealants.

.2 Text to complete other various Sections containing sealant or caulking specifications, including Section 07 52 00.

1.2 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 C920-14a, Standard Specification for Elastomeric Joint Sealants.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.2 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.3 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

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

.1 Material Safety Data Sheets (MSDS).

.5 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 SUBMITTALS

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

.2 Manufacturer's product data: Submit manufacturer’s printed product data to describe:

.1 Caulking compound.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Samples: Submit duplicate samples of each type of material and colour.

.1 Submit cured samples of exposed sealants for each color where required to match adjacent material.

.4 Manufacturer's Installation Instructions: Instructions to include installation instructions for each product used.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 61 00.

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

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.6 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.

.7 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.

.8 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.

.9 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°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.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

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

.3 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans]

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.

.1 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.

.2 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Polyurethane:

.1 Type S-1: One component, non-sag, for general construction, Shore A Hardness 15+, conforming to CAN/CGSB-19.13, Type 2, MCG-2-25-A-N and ASTM C920, Type S, Grade NS, Class 25, Use NT, M, and A, colour to be selected by Departmental Representative from manufacturer’s standard range.

.2 Silicone:

.1 Type S-2: Mould and mildew resistant, Shore A Hardness 15-25, one component conforming to CAN/CGSB-19.13 and ASTM C920, primerless, Type S, Grade NS, Class 25, use NT, G, and A, SWRI validated.

.2 Type S-3: Exterior Weatherproofing Sealant, One part, low modulus, neutral cure, Shore A Hardness 15 25, conforming to CAN/CGSB 19.13 M, Classification C 1 40 B N and C 1 25 B N, and ASTM C 920, Type S, Grade NS, Class 25, use NT, M, G, A and O, colour as selected by Departmental Representative from manufacturer’s standard range.

.3 Acrylic Latex:

.1 Type S-4: One part acrylic latex, Shore A Hardness 20, conforming to CAN/CGSB-19.17 and ASTM 834.

.4 Acoustical Sealant:

.1 Type S-5: Non-skinning, non-hardening, single component synthetic rubber sealant, conforming to ASTM C919, primerless, Type S, Grade NS, Class 25, SWRI validated.

.5 Multi-Component:

.1 Type S-6: Saw cut sealant, multi-component, self levelling, conforming to ASTM D2240.

.2 Type S-7: Two part multi-component sealant; chemical curing, non sag, exterior wall sealant, Shore A Hardness 20-35, conforming to CAN/CGSB 19.24 M, Type 2, Class B, and ASTM C920, Type S, Grade NS, Class 25, use NT, M, and A.

.6 Preformed Compressible and Non-Compressible back-up materials.

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

.1 Extruded open or closed cell foam backer rod.

.2 Size: oversize 30 to 50%.

.2 Neoprene or Butyl Rubber.

.1 Round solid rod, Shore A hardness 70.

.3 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.

.4 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

.1 Where no specified type of sealant is shown or specified choose one of the sealants specified in this Section applicable to that intended application, and consistent with manufacturer's recommendations.

.2 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, precast masonry): Sealant Type S-7.

.3 Seal interior perimeters of exterior openings as detailed on drawings: Sealant type: S-4.

.4 Interior control and expansion joints in floor surfaces: Sealant Type S-6.

.5 Perimeters of interior frames, as detailed and itemized: Sealant Type S-4.

.6 Perimeter of bath fixtures (e.g. sinks, tubs, urinals, stools, waterclosets, basins, vanities): Sealant Type S-2.

.7 Exposed interior control joints in drywall: Sealant Type S-1.

2.4 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

Part 3 EXECUTION

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 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.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant.

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing.

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup.

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

- .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM B29-03(2009), Standard Specification for Refined Lead.
- .3 ASTM B749-03(2009), Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- .4 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .5 ASTM E413-10, Classifications for Rating Sound Insulation.
- .6 ASTM E1332-10a, Standard Classification for Rating Outdoor-Indoor Sound Attenuation.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.3 Canadian Standards Association (CSA International)

- .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door Manufacturers' Association (CSDMA)

- .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
- .2 CSDMA, Selection and Usage Guide for Commercial Steel Door and Frame Products, 2009.

.5 National Fire Protection Association (NFPA)

- .1 NFPA 80-2013, Standard for Fire Doors and Other Opening Protectives.
- .2 NFPA 252-2012, Standard Methods of Fire Tests of Door Assemblies.

.6 South Coast Air Quality Management District (SCAQMD), California State

- .1 SCAQMD Rule 1113-04, Architectural Coatings.
- .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.7 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S104-10, Standard Method for Fire Tests of Door Assemblies.
- .2 CAN/ULC-S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.

.3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.4 CAN/ULC-S702-14, Standard for Thermal Insulation, Mineral Fibre, for Buildings.

.5 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 for ratings specified or indicated.

.2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC-S104, ASTM E152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.3 SUBMITTALS

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

.2 Provide product data: in accordance with Section 01 33 00.

.3 Provide shop drawings: in accordance with Section 01 33 00.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware and fire rating and finishes.

.3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.

.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 11.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts, minimum 30% recycled content.

.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75, minimum 30% recycled content.

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m^3 minimum sanded to required thickness.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.2 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Section 09 91 23. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Door bottom seal: As specified in Section 08 71 11.

.5 Metallic paste filler: to manufacturer's standard.

.6 Fire labels: metal riveted.

.7 Sealant: As specified in Section 07 92 00.

.8 Glazing: As specified in Section 08 80 50.

.9 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.

.2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Interior frames: 1.6 mm welded type construction.

.4 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.5 Protect mortised cutouts with steel guard boxes.

.6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.7 Manufacturer's nameplates on frames and screens are not permitted.

.8 Conceal fastenings except where exposed fastenings are indicated.

.9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Interior doors: honeycomb construction.

.3 Fabricate doors with longitudinal edges locked seam. Seams: visible.

.4 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.6 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.8 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104 list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.9 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

.1 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

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 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder where required.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, noncombustible sill, and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 50.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Architectural Manufacturers Association (AAMA)

.1 AAMA 609/610-09, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.

.2 ASTM International

.1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.

.2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

.4 CSA International

.1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 Environmental Choice Program (ECP)

.1 CCD-045-95, Sealants and Caulking Compounds.

.6 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.7 The Master Painters Institute (MPI) / Architectural Painting Specification Manual - February 2004.

.1 MPI# 79 - Primer, Alkyd, Anti-Corrosive for Metal.

.8 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for doors and frames 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 Ontario, Canada.

.2 Indicate materials and profiles and provide full-size, scaled details of components for each type of door and frame. Indicate:

.1 Interior trim and exterior junctions with adjacent construction.

.2 Junctions between combination units.

.3 Elevations of units.

.4 Core thicknesses of components.

.5 Type and location of exposed finishes, method of anchorage, number of anchors, supports, reinforcement, and accessories.

.6 Location of caulking.

.7 Each type of door system including location.

.8 Arrangement of reinforcing for hardware and joints.

.9 Arrangement of hardware and required clearances.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit one 300 x 300 mm corner sample of each type door and frame.

.4 Submit sample showing glazing detail, reinforcement, finish and location of manufacturer's nameplates.

.5 Frame sample to show glazing stop, door stop, jointing detail, finish.

.5 Manufacturers Reports:

.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

.6 Submit in accordance with Section 01 78 00.

.7 Operation and Maintenance Data: submit operation and maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual.

1.3 QUALITY ASSURANCE

.1 Certifications: 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, store and handle materials in accordance with Section 01 61 00 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.

.1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Use coatings that are easy to remove and residue free.

.2 Leave protective covering in place until final cleaning of building.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect aluminum doors and frames from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Size glass thickness and glass unit dimensions to limits in accordance with CAN/CGSB-12.20.

2.2 MATERIALS

.1 Aluminum extrusions: to Aluminum Association alloy AA 6063-T5 anodizing quality.

.2 Sheet aluminum: to Aluminum Association alloy AA 1100-H14 anodizing quality.

.3 Steel reinforcement: to CSA G40.20/G40.21, grade 300 W.

.4 Fasteners: aluminum, finished to match adjacent material.

.5 Door bumpers: black neoprene.

.6 Door bottom seal: operable and automatic door seal of anodized extruded aluminum frame and vinyl weather seal, recessed in door bottom, closed ends, automatic retract mechanism when door is open.

.7 Isolation coating: alkali resistant.

.8 Glass: tempered glass to CAN/CGSB-12.1, Type 1, Class A.

.9 Sealants: colour selected by Departmental Representative in accordance with Section 07 92 00.

2.3 ALUMINUM DOORS

.1 Construct doors of porthole extrusions with minimum wall thickness of 2.4 mm.

.2 Door stiles nominal 100 mm wide plus or minus 6 mm.

.3 Top rail nominal 150 mm wide plus or minus 6 mm.

.4 Bottom rail nominal 250 mm wide plus or minus 6 mm.

.5 Reinforce mechanically-joined corners of doors to produce sturdy door unit.

.6 Glazing stops: interlocking snap-in type for dry glazing. Exterior stops: tamperproof type.

2.4 ALUMINUM FRAMES

2.5 Construction: Non-thermally broken, with glass mounted centre of frame.

2.6 Dimensions: Nominal 50 mm face x 115 mm deep total frame profile, with glazing throat to accommodate 6 mm single glazed unit.

2.7 ALUMINUM FINISHES

.1 Clear anodic finish: to designation AA-A31.

.2 Appearance and properties of anodized finishes designated by Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

2.8 STEEL FINISHES

.1 Finish steel clips and reinforcing steel with zinc coating to ASTM A123/A123M.

2.9 FABRICATION

.1 Doors and framing to be by same manufacturer.

.2 Fabricate doors and frames to profiles and maximum face sizes as indicated. Provide minimum 22 mm bite for insulating glazed units.

.3 Provide structural steel reinforcement as required.

.4 Fit joints tightly and secure mechanically.

.5 Conceal fastenings.

.6 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware using templates provided under Section 08 71 12.

.7 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum doors and frames 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 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Set frames plumb, square, level at correct elevation in alignment with adjacent work.

.3 Anchor securely.

.4 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.

.5 Adjust door components to ensure smooth operation.

.6 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.

.7 Glaze aluminum doors and frames in accordance with Section 08 80 50.

.8 Apply sealant in accordance with Section 07 92 00. Conceal sealant within the aluminum work except where exposed use is permitted by Departmental Representative.

3.3 FIELD QUALITY CONTROL

.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:

.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 3 days of review and submit.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Perform cleaning of aluminum components in accordance with AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.

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

.4 Clean aluminum with damp rag and approved non-abrasive cleaner.

.5 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.

.6 Clean glass and glazing materials with approved non-abrasive cleaner.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by aluminum door and frame installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Architectural Manufacturers Association (AAMA):

.1 AAMA 1304-02, Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems

.2 American Society for Testing and Materials International (ASTM):

.1 ASTM D256-10, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

.2 ASTM D570-98 (2010)e1, Standard Test Method for Water Absorption of Plastics

.3 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics

.4 ASTM D790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

.5 ASTM D1761-12, Standard Test Methods for Mechanical Fasteners in Wood.

.6 ASTM D2583-13a, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

.7 ASTM D5420-10, Standard Test Method for Impact Resistance of Flat Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)

.8 ASTM D6670-13, Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products

.9 ASTM E84-15a, Standard Method of Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

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

.2 Provide product data, including description of materials, components, fabrication, finishes, and installation.

.3 Provide shop drawings: in accordance with Section 01 33 00.

.1 Indicate each type of door, material, core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware and fire rating and finishes.

.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.

.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.3 QUALITY ASSURANCE

.1 Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of ten (10) years successful experience.

.2 Door and frame components from same manufacturer.

.3 Evidence of a compliant documented quality management system.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.

.3 Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

.4 Handling: Protect materials and finish from damage during handling and installation.

.5 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 11.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.

.2 Forced Entry Resistance in accordance with AAMA1304: Pass

.3 Indoor air quality testing per ASTM D6670: GREENGUARD Environmental Institute Certified including GREENGUARD for Children and Schools Certification

.4 Screw Pullout in accordance with ASTM D1761-06, Minimum 420 kg.

.5 Surface Burning Characteristics, Class A Option both faces of FRP Interior Panels in accordance with ASTM E84:

.1 Flame Spread: Maximum of 25.

.2 Smoke Developed: Maximum of 450.

.6 FRP Face Sheet Properties:

.1 Izod Impact Strength, ASTM D256, Minimum 373 J/m notched.

.2 Tensile Strength, ASTM D638, Minimum 124 MPa.

.3 Tensile Modulus, ASTM D638, Minimum 124 GPa.

.4 Water Absorption, ASTM D570, Maximum 0.16% / 24 hours at 25°C.

.5 Flexural Strength, ASTM D790, Minimum 186 MPa.

.6 Flexural Modulus, ASTM D790, Minimum .4.8 GPa.

.7 Barcol Hardness, ASTM D2583, Minimum 40.

.8 Gardner Impact Strength, ASTM D5420, Minimum 3.3 N-m.

2.2 DOORS

.1 Construction:

.1 Door Thickness: 45 mm.

.2 Construction: Fabricate using insulated pultruded stiles and rails with 2.3 mm fibrerglass reinforced plastic (FRP) face sheets. Secure stiles and rails at corners with pultruded corner clip.

.3 Reinforcement: Solid high-density urethane shapes to be chemically welded at factory.

.4 Top Rail: Pultruded FRP insulated stile material.

.5 Bottom Rail: Pultruded FRP insulated stile material.

.2 Core: Polypropylene Honeycomb.

.3 Cutouts:

.1 Manufacture doors with cutouts for required vision lites, louvers, and panels.

.2 Factory install vision lite kits, louvers, and panels.

.4 Door Hardware: Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

.5 Fasteners:

.1 Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.

.2 Compatibility: Compatible with items to be fastened.

2.3 FRAMING SYSTEMS

.1 Size and Type: As indicated on Drawings.

.2 Materials: 6 mm thick solid pultruded FRP profiles having no corrosive components or reinforcement.

.3 Width: 51 mm face.

.4 Depth: To suit wall construction.

.5 Assembly: Knock down (KD) for field assembly.

.6 Door Stop: 16 mm x 57 mm.

.7 Corner Construction: Mitered with 51 mm x 51 mm x 10 mm pultruded FRP angle reinforcement with interlocking pultruded FRP brackets.

.8 Reinforcing: 6 mm pultruded FRP chemically welded at all hinge, strike and closer locations.

.9 Anchors: Furnished with type as recommended by manufacturer for wall construction.

.10 Fasteners for reinforcing: 18-8 Stainless Steel.

2.4 VISION LITES

.1 Factory Applied Stops for Glazing Aluminum, FRP: 6 mm glass.

.2 Lite Size:

.1 Size: Half lite.

2.5 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Sealant: As specified in Section 07 92 00.

.3 Glazing: As specified in Section 08 80 50.

2.6 FABRICATION

.1 Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on Drawings.

.2 Assembly: Complete cutting, fitting, forming, drilling, and chemically welding of FRP before assembly.

.3 Fit:

.1 Maintain continuity of line and accurate relation of planes and angles.

.2 Secure attachments and support at mechanical joints with hairline fit at contacting members.

.4 Hardware Preparation:

.1 Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule. Reinforce for specific hardware locations.

.2 Hardware Schedule: As specified in Section 08 71 11.

2.7 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.8 FINISH

.1 Finish for Door Edges and Frames: Primer Only.

.2 Finish for Face Sheet: Finish color throughout.

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 areas to receive doors. Notify Departmental Representative of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.3 PREPARATION

.1 Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.4 INSTALLATION

.1 Install doors and frames to CSDMA Installation Guide.

.2 Install doors in accordance with manufacturer's instructions.

.3 Install doors plumb, level, square, true to line, and without warp or rack.

.4 Anchor frames securely in place.

.5 Set thresholds in bed of mastic and backseal.

.6 Install exterior doors to be weathertight in closed position.

.7 Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Departmental Representative.

.8 Remove and replace damaged components that cannot be successfully repaired as determined by Departmental Representative.

3.5 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder where required.

3.6 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 11.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, noncombustible sill, and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.7 ADJUSTING

.1 Adjust doors, hinges, and locksets for smooth operation without binding.

3.8 CLEANING

.1 Clean doors promptly after installation in accordance with manufacturer's instructions.

.2 Do not use harsh cleaning materials or methods that would damage finish.

3.9 PROTECTION

.1 Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of Substantial Performance of the Work.

3.10 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 50.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 06 40 01: Hardware for cabinets and coat hooks.

.2 Section 08 11 13: Hollow metal door frames.

.3 Section 08 11 17: Hardware for aluminum doors.

.4 Section 08 34 59: Hardware for vault door.

.5 Section 08 71 12: Swing door operator.

.6 Section 26 05 34: Conduit and wiring for electrical hardware.

1.2 PRODUCT DATA SHEETS

.1 Submit one copy of product data sheets in accordance with Section 01 33 00 and 01 78 00.

.2 Product data sheets shall consist of catalogue cuts, manufacturer's name and number, finish and reference identification to specified standard.

1.3 SCHEMATIC DIAGRAMS

.1 Submit schematic diagrams of electrical components for inclusion in maintenance manual specified in Section 01 33 00 and 01 78 00.

1.4 REFERENCES

.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by CSDMA - Canadian Steel Door Manufacturers' Association and CSA B651-12, Accessible Design for the Built Environment.

.2 Use abbreviations and symbols recommended in "Abbreviations and Symbols as used in Architectural Door and Hardware Schedules and Specifications", 1983, published by the Door and Hardware Institute.

.3 Use hardware schedule format recommended in "Sequence and Format for the Hardware Schedule", June, 1984, published by the Door and Hardware Institute.

1.5 DEFINITIONS

.1 Master Key (MK):

.1 A key which operates all the master keyed locks or cylinders in a group, each lock or cylinder usually operated by its own change key.

.2 To combinate a group of locks or cylinders such that each is operated by its own key as well as by a master key for the entire group.

.2 Master Key System:

.1 Any keying arrangement which has two or more levels of keying.

.2 A keying arrangement which has exactly two levels of keying.

.3 Grand Master Key (GMK): The key which operates two or more separate groups of locks, each operated by a different master key.

.4 Grand Master Key System: A master key system which has exactly three levels of keying.

.5 Great Grand Master Key (GGMK): The key which operates two or more separate groups of locks, which are each operated by a different grand master key.

.6 Great Grand Master Key System: A master key system which has exactly four levels of keying.

.7 Top Master Key (TMK): The highest level master key in a master key system.

1.6 REGULATORY REQUIREMENTS

.1 Use ULC listed and labelled hardware for doors in fire rated partitions and fire exits.

.2 Use UL 437 listed cylinders in locking devices to security rating indicated.

1.7 HARDWARE LIST

.1 Submit hardware schedule in accordance with Section 01 33 00 and 01 78 00.

.2 Submit literature cuts, indicating hardware proposed, including make, model, base material, function, ANSI Function where ANSI used in this specification, Grade, Type, Series, BHMA finish, trim, ULC listing, UL listing, manufacturer and other pertinent information. Indicate which model or accessory is being provided where more than one model or accessory appears on a page.

Part 2 PRODUCTS

2.1 KEYING, ACCESSORIES AND FINISH

.1 Each lock different key under existing great grand master key GGMK, 2 keys per lock, 2 master keys.

.1 Keying systems: to ANSI/BHMA-A156.28- 2013.

.2 Provide accessories with hardware.

.3 626 finish (satin chrome plated on brass or bronze) unless noted otherwise.

.4 Finish fasteners to match the exposed surface on which they appear.

.5 Provide temporary construction keying.

.6 Final keying: to ANSI/BHMA-A156.5-2010, Grade 1.

.7 Security cylinder (interchangeable core): 6 pin, brass, restricted keyway, rated high security to UL 437 listed, key duplication by registered signatures only.

.8 Use lock and latch sets with solid metal, U shape, lever handles meeting requirements of CSA B651-12, Accessible Design for the Built Environment, clause 5.2.7 Door Hardware and Figure 20, unless specified otherwise.

.9 Provide lever handles of same style for bored and mortise locksets.

.10 Door prep: to ANSI/BHMA-A156.115-2014 for steel doors and frames and ANSI/BHMA-A156.115-W-2006 for wood doors and frames.

2.2 MATERIALS

.1 Hinge: to ANSI/BHMA-A156.1-2013, Grade indicated, 626 satin chrome, use anti-friction (ball) bearing hinges with closers, one hinge for each 750 mm of door height, 101 mm hinges for 38 mm doors, 115 mm hinges on 45 mm doors, 125 mm hinges on 50 mm doors, button tips, non- rising removable pins unless indicated NRP on hardware schedule.

- .1 Interior:
  - .1 Grade 1: A8111 - heavy weight, steel, 4 ball bearing.
  - .2 Grade 2: A8112 - standard weight, steel, 2 ball bearing.
  - .3 Grade 3: A8133 - standard weight, steel, plain bearing.
- .2 Exterior:
  - .1 Grade 1: A2111 - heavy weight, bronze, 4 ball bearing.
  - .2 Grade 2: A2112 - standard weight, bronze, 2 ball bearing.
  - .3 Grade 3: A2133 - standard weight, bronze, plain bearing.

.2 Double acting spring hinge: to ANSI/BHMA- A156.17-2014, Type K81151, mortised in door, surface applied to jamb, double acting, adjustable tension, torsion springs.

.3 Door closer: to ANSI/BHMA-A156.4-2013, Grade 1, [C02011 hinge side mounting,] [C02021 parallel arm mounting,] [[C02041 top jamb mounting,][and adaptor plates,]] surface closer, modern type with cover, sprayed enamel finish, metallic [689 aluminum] [690 dark bronze] [691 light bronze] [692 tan], size to suit door width and mass, [[hold-open arm], [dead stop,] [integral shock absorbing back check,] [variable backcheck position valve] [heavy-duty shock-absorber arm] [as indicated]]. [Closers will have been tested to 10,000,000 cycles without failure where required by hardware schedule.] Disabled access doors: to operate at a minimum pressure not exceeding 38 N for exterior doors, 22 N for interior doors and close in not less than 5 seconds from an open position of 90°.

.4 Fire/Life Safety closer/holder: to ANSI/BHMA- A156.15-2011, when current is interrupted, hold-open releases and door closes, [multi-point] hold open, rack and pinion door closer when hold-open not engaged or current is interrupted, with both isolated normally open and normally closed dry contacts for interface with alarm system, adjustable hydraulic backcheck, 120 V AC input option.

.5 Overhead [holder] [stop]: to ANSI/BHMA- A156.8-2010, [concealed] slide type, 110° opening, stop and shock absorber effective at all times. [, hold open and release by push and pull, except when exposed control is set in inactive position.] Function [C01511 Type 1 concealed] [C04541 Type 2 surface].

.6 Lock and latch set (bored): to ANSI/BHMA- A156.2-2011, Series 4000, Grade [1], [2], bolted through door, ANSI door prep ANSI/BHMA-A156.115- 2006 for steel doors and frames and ANSI/BHMA-A156.115-W-2006 for wood doors and frames, deadlatching bolt, function indicated, 626 satin chrome[, UL 437 listed cylinder, [_____] [high] security].

.7 Lock and latch set (mortised): to ANSI/BHMA- A156.13-2012, Operational Grade 1, Security Grade [1] [2], lock trim lever and [escutcheon] [rose] with cylinder on exterior, lock trim lever and rose trim with thumb turn on interior, anti-friction latch bolt, function indicated, UL 437 listed cylinder.

.8 Dead lock (mortised): to ANSI/BHMA-A156.5- 2014, function [E06071] [E06072], dead bolt by key outside and turn piece inside, UL 437 listed cylinder with guard.

.9 Dead lock (mortised): to ANSI/BHMA-A156.5- 2014, function [E06061] [E06062], dead bolt by key outside and key inside, UL 437 listed cylinder with guard.

.10 Auxiliary dead lock (bored): to ANSI/BHMA- A156.5-2014, operated by key outside and by turn from inside. Function E0151. UL 437 listed cylinder.

.11 High security dead lock (mortised): to ANSI/BHMA-A156.5-2014, function indicated, dead bolt, UL 437 listed cylinder with guard, thumb turn.

.12 Security dead bolt: to ANSI/BHMA-A156.[_____], rotating discs, hardened steel cylinder, 25 mm bolt, solid brass cylinder guard, factory restricted, federal government keyway, UL 437 listed cylinder.

.1 Acceptable material: "Model 2234 - Abloy II Disklock" manufactured by Assa Abloy Canada, 905-940-2040 www.assaabloy.com.

.13 Locker locks: to ANSI/BHMA-A156.11-2014, Function [E07241, key projects and retracts dead bolt, surface mounted] [E07251, key retracts latch bolt, key removable in locked position only, surface mounted].

.14 Hospital latch: 19 mm latch bolt, 626.

.15 Barrel bolt: to ANSI/BHMA-A156.16-2013, Type L14121, mortised, brass.

.16 Mechanical lock: pushbutton mechanism, combination lock, to ANSI/BHMA-A156.5-2014, Function [E0311] entry by combination [or key bypass], inside lever always free, combination changed by separate key cylinder on inside of door, 19 mm throw dead latch, 3 hour ULC listed latch mechanism, beveled strike, interior mounted, finish [626 satin chrome].

.17 Electronic lock: touchpad combination lock, entry by combination or key bypass, inside lever always free, combination changed from keypad, 19 mm throw deadlocking latch bolt, 25 mm throw deadbolt, inside lever retracts both bolts, outside key projects deadbolt, [battery powered,] [pressure contact battery recharging,] [626 satin chrome plated.] [630 satin stainless steel.]

.1 Acceptable material: [T8797(FL) Mortised 19 Entrance Lock with Deadbolt (lever)] [T5491 Entrance Lock (bored)] 'Touchcode 16 Electronic Lock' by Yale Security, 905-564-5854 or 800-461-3007, www.yalesecurity.com.

.18 Lock and latch set (electric mortised): to ANSI/BHMA-A156.13-2012, Operational Grade 1, Series 1000, fail secure electric lock with monitoring, 24 volt, digital keypad, 19 mm latch throw, continuous duty solenoid, interconnected to alarm system, UL38G5 listed for fire and locking.

.1 Function: door normally closed, latched and secure. Inside lever always operable and shunts alarm. Alarm will sound if door is not closed within 5 seconds preset time limit, programmable by alarm panel. Outside lever always locked. Entry by valid code. Mechanical key in trim retracts latchbolt for entry. Key can only be removed in locked position. Outside trim remains locked during power failure.

.2 Acceptable material: '8791FL x REX Fail Secure Electric Lock, MPS10 Power Supply, PTH6 Electric Hinge, 917 Keypad, MC-4 Door Position Switch' manufactured by Yale Disivion of Assa Abloy 800-461-3007, www.yalesecurity.com and www.assaabloy.com.

.19 Exit device: to ANSI/BHMA-A156.3-2014, Grade 1, flat push pad type design with removable cover plates concealing mechanism and fasteners. Mechanism case with minimum average wall thickness of 3.5 mm. All internal parts zinc dichromated to resist corrosion. Internal springs - compression type. Complete with UL 437 listed cylinder. [Type 3 mortise device latching into electric strike on inactive door leaf, Function 03 Entrance by trim when latch bolt is released by key. Key removable only when locked.]

.20 Exit Device Trim: to ANSI/BHMA-A156.6-2010, [Type J401 - standard,] [Type J402 - offset,] [stainless steel] pull, [and [1.27] [3.2] mm stainless steel pull plate.

.21 Life safety/high security exit device: to ANSI/BHMA-A156.3-2014, Grade 1, flat push pad type design with removable cover plates concealing mechanism and fasteners. Automatic dead bolt. Stainless steel base metal. Type 1, rim device[, UL 437 listed cylinder]. Configuration [HS - Exit Device (night latch) and deadbolt. Key retracts deadbolt, separate key retracts latch bolt.] [HS (exit only) - Exit device and deadbolt, no outside function.] [HSD - Exit device and dial combination deadbolt. Key retracts latch bolt.] [ELHS - Electric latch retraction exit device and deadbolt. Key retracts deadbolt.] [ELHSD - Electric latch retraction exit device and dial combination deadbolt.]

.22 Controlled exit device: to ANSI/BHMA-A156.3- 2014, Grade 1, ULC Labelled, flat push pad type design with removable cover plates concealing mechanism and fasteners. [UL 437 listed cylinder.] Conforming to requirements of NBC 2010, Division B, 3.4.6.16, door signage, [nuisance alarm] [and nuisance delay,] [remote alarm,] [key switch for arming/disarming unit,] [status indicator lamp,] [internal horn,] [door position input,] [external inhibit input.] Upon release, the locking device must be reset manually by the actuation of the auxiliary switch accessible only to authorized personnel. [Compatible with and interconnected with: electro-magnetic lock, proximity card reader and fire alarm system.]

.23 Electro-magnetic lock: ULC listed, single door application with door position switch, 1200 pound holding power, complying with NBC 2010, clause 3.4.6.16. [Compatible with and interconnected with: controlled exit device, proximity card reader and fire alarm system.]

.24 Normal strikes: box type, lip projection not beyond jamb [ASA dimensions].

.25 Keeper switch: limit switch built into door frame for indicating the lock bolt is in the locked or unlocked position, for use with standard ASA strike plate, will accept one- inch bolt throw. Position switch is adjustable for mortise or cylindrical locksets. Depth of switch tripper is adjustable for bolt throw.

.1 Acceptable material: "ASSW-104A Keeper Switch" manufactured by Folger Adam Co. www.folgeradamedc.com division of Assa Abloy 1 800-966-6739, distributed by Strongbar Industries Inc., 905-828-5709; and "028 Indicator Switch" manufactured by Yale Security, distributed by ARD Inc., (416) 798-8955.

.26 Lock protector/latch guard: 2 mm thick [stainless] steel, with security frame pin to prevent separation of door and frame, no exposed fasteners on face, S-6 finish to match bronze anodized doors, [cadmium plated] [630 stainless steel] elsewhere.

.1 Acceptable material: 'IVES LG Series' manufactured by Glynn-Johnson www.glynn-johnson.com division of Ingersoll-Rand 905-278-6128 www.ingersoll-rand.com.

.27 Strike bucket: strike bucket accepting a 25 mm throw deadlock. Grouted or wedged in the area of the strike bucket to prevent spreading.

.28 Electric strikes: to ANSI/BHMA-A156.[5-2014][31 -2013], Grade [1,] [2,] fail [secure,] 4.8 mm horizontal adjustment capability, [dual monitor switches,] [silent operation,] [entry buzzer,] [E59321 - Mortised: for use with locks not having dead bolts, use also with mortise exit devices.] [E59311 - Semi Rim Mounted: for use with rim exit devices on single doors and surface vertical rod exit devices.] [E59331 - Mortised: for use with locks on single doors having latch bolts and 25 mm throw dead bolts.]

.29 Power transfer: non-load bearing, concealed when door closed, UL listed for Burglary Protection and Class 1 low voltage installation, rated for and compatible with power supply and electric latch, ten 24 gauge wires, 24VDC, 1 ampere.

.1 Acceptable material: 'EPT-10' manufactured by Von Duprin 905-278-6128 www.vonduprin.com division of Ingersoll-Rand www.irsafetyandsecurity.com.

.30 Door pull: to ANSI/BHMA-A156.6-2010, type [J401 straight] [J402 offset] [J405 straight with 1.27 mm escutcheon plate] [J407 straight with 3.2 mm escutcheon plate], 225 mm centres, [surface] [through bolt] mounted.

.31 Flush pull: to ANSI/BHMA-A156.6-2010, type J403, [aluminum] [stainless steel].

.32 Push plate: to ANSI/BHMA-A156.6-2010, type J301, rectangular, square 90° corners, beveled edges, [_____] mm wide x [_____] mm high.

.33 Kick plate: to ANSI/BHMA-A156.6-2010, type [J106 plastic] [[J102 [aluminum] [stainless steel]], 1.55 x 250 mm x door width, 3 beveled edges.

.34 Mop plate (half door): to ANSI/BHMA-A156.6- 2010, type J103 stainless steel, 1.55 x 900 mm x door width, 3 beveled edges.

.35 Wall type bumper: to ANSI/BHMA-A156.16-2013, type L42101, finish 628, convex pad, concealed fasteners.

.36 Wall type door stop: to ANSI/BHMA-A156.16- 2013, type L02011, finish 628, overall projection 89 mm, attached by surface screws.

.37 Floor door stop: to ANSI/BHMA-A156.16-2013, dome type, cushion secured by concealed fasteners, anti-rotation stud, type L22141 finish 626 for doors without threshold and type L22161, finish 626 for doors with threshold.

.38 Door holder: to ANSI/BHMA-A156.16-2013, Type L01301, hold-open and release by push and pull on door, surface mounted.

.39 Flush slide bolt: to ANSI/BHMA-A156.16-2013, type L04201, [200] [300] mm long rod, 606.

.40 Lever extension flush bolt: to ANSI/BHMA- A156.16-2013, type [L14081] [L14251 fire rated], cast brass, 300 mm long rod, 19 mm backset, mortised keeper, [628] [606].

.41 Threshold: to ANSI/BHMA-A156.21-2009, type J32190, [125] [150] mm wide, aluminum [plain] [serrated] exposed surface, rigid PVC thermal break for exterior thresholds, [square butt edge[s]], [prepared for vertical rod], finish 628.

.42 Ramp threshold 19 mm rise: to ANSI/BHMA- A156.21-2009, type J38130, aluminum, serrated and slip resistant surface with abrasive coating, to accommodate the 19 mm rise, width to suit 920 mm ramp, ADA compliant.

.1 Acceptable material: 'Interlocking Ramp Threshold R75 and R75DBK' manufactured by National Guard Products Inc., 800-647-7874 www.ngpinc.co, distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.43 Ramp threshold 12 mm rise: to ANSI/BHMA- A156.21-2009, type J38130, aluminum, serrated and slip resistant surface with abrasive coating, to accommodate the 19 mm rise, width to suit 920 mm ramp, ADA compliant.

.1 Acceptable material: 'CT-808' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123, www.kncrowder.com; 'Interlocking Ramp Threshold R50 and R50DBK' manufactured by National Guard Products Inc., 800-647-7874 www.ngpinc.co, distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.44 Extended rain drip: extruded aluminum, 63 mm projection x full frame width.

.45 Meeting stile weatherstrip: surface applied, tamperproof screws, woven pile insert in extruded aluminum frame on one door, solid insert in extruded aluminum frame on second door, clear anodized, two part adjustable surface astragal, ULC rated in fire separations.

.1 Acceptable material: 'No. 155' manufactured by Zero International www.zerointernational.com, distributed by J.M.T. Phillips division of Yale-Crobin 905-823-4881; and '140PA' manufactured by K.M. Thomas (416) 798-0611 www.kmthomas.com.

.46 Interlocking deadbolt for bi-folding doors: to ANSI/BHMA-A156.5-2014, Type E06272, operated by key from outside and by turn from inside.

.47 Bifold door hardware: to ANSI/BHMA-A156.14- 2013, type D8621, 18 kg capacity with valance.

.48 Sliding door hardware: to ANSI/BHMA-A156.14- 2013.

.1 Rail and hangar sets: D8011 rated 109 kg and hangar D8151.

.2 Bumper stop for bi-passing doors: Type D8771.

.3 Floor guide: Type D0811.

.4 Flush pull: Type D8431, 626 or 630.

.5 Edge pull: Type 2801 mortised for door pocket.

.6 End Guide and stop: Type D8471.

.7 Sliding door latch: Type D0821.

.49 Closet door pull: to ANSI/BHMA-A156.9-2010, type B32011, finish 628, satin aluminum, 90 mm.

.50 Smoke seal gasketing: extruded aluminum, mill finish, surface screw applied to pull side of door, at head, jamb and meeting stile, solid neoprene tube, tested to ASTM E283-04.

.1 Acceptable material: 'No. 328' manufactured by Zero International www.zerointernational.com, distributed by J.M.T. Phillips division of Yale-Corbin 905-823-4881; '137N' manufactured by K.M. Thomas 416-798-0611 www.kmthomas.com; and 'W-50' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com.

.51 Smoke/sound seal gasketing: to ANSI/BHMA- A156.22-2012, Function ROY154, solid neoprene or silicone tube, self adhesive, tested to ASTM E283-04, cUL 1-1/2 hours.

.1 Acceptable material: 'W-21' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com; and '5050' manufactured by National Guard Products, 800-647-7874 www.ngpinc.com, distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.52 Meeting stile weatherstrip for tempered glass doors: surface applied with silicone gel adhesive, nylon brush pile insert in clear plastic U shape extrusion, brush length 10.4 mm, to match existing.

.1 Acceptable material: 'AP10GLS04BL' manufactured by Sealeze 800-446-7325 distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.53 Brush weatherstrip: densely compressed nylon filaments encased in [clear] [dark bronze] anodized aluminum retainers, 35 degree angle on head and jamb:

.1 Acceptable material: '602' head and jamb and 'OV633A' sweep manufactured by National Guard Products 800-647-7874 www.ngpinc.com, distributed by K.M. Thomas 416-798-0611 www.kmthomas.com. 416-798-0611.

.54 Meeting stile weatherstrip for existing pair of aluminum main entrance doors: densely compressed nylon filaments to replace existing encased in anodized aluminum retainers, filament length to suit gap between doors. Nylon filament only. Existing aluminum retainer to remain.

.55 Meeting stile weatherstrip: densely compressed nylon filaments encased in clear anodized aluminum retainers.

.1 Acceptable material: '185P Split Astragals' manufactured by National Guard Products 800-647-7874 www.ngpinc.com, distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.56 Sweep: densely compressed nylon filaments encased in clear anodized aluminum retainer, for mounting in the inverted bottom channel.

.1 Acceptable material: 'D648' manufactured by National Guard Products 800-647-7874 www.ngpinc.com, distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.57 Weatherstrip: non-rigid, extruded vinyl chloride polymer or copolymer bulb or strip in aluminum strip at head and jamb, fixed:

.1 Acceptable material: '108NA' manufactured by K.M. Thomas 416-798-0611 www.kmthomas.com; 'W6' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com; and '122N' manufactured by National Guard Products 800-647-7874 www.ngpinc.co.

.58 [Weatherstrip:] [Sound seal gasketing:] to ANSI/BHMA-A156.22-2012, similar to Function ROY154 tube or ROY155 except flat pad, solid neoprene or silicone tube or pad, self adhesive, tested to ASTM E283-04, cUL 1-1/2 hours. adhered to face of head and jambs of door frame.

.1 Acceptable material: '312N' manufactured by Zero International www.zerointernational.com, distributed by J.M.T. Phillips division of Yale-Corbin 905-823-4881; 'No. W-21' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com; and '361' manufactured by National Guard Products, 800-647-7874 www.ngpinc.com, distributed by K.M. Thomas 877-798-0611 www.kmthomas.com.

.59 Set of sound seals: system providing STC-42 when tested in accordance with ASTM E90-09 and ASTM E1408-91(2000). System made up of auto door bottom, double jamb and head seals and threshold.

.1 Acceptable material: '5050' jamb seals, ['423N' mortised] ['[_____]' surface] auto door bottom, and '513' threshold manufactured by National Guard Products 800-647-7874 www.ngpinc.com, and distributed by K.M. Thomas 877-798-0611 www.kmthomas.com.

.60 Padlock: high security padlock, inter- changeable core, keyed under master keying system and/or group.

.61 Door bottom seal: 'C' shape vinyl seal in aluminum frame, exterior drip cap, closed ends, face flush with door.

.62 Automatic door bottom(surface mounted): operable and automatic door seal of aluminum frame and neoprene seal, automatic retract mechanism when door is open, listed and labelled for use in 90 min. fire doors, in accordance with ASTM E2074-00e1 and CAN/ULC-S104-10.

.1 Acceptable material: '#361' manufactured by Zero International www.zerointernational.com, distributed by J.M.T. Phillips division of Yale-Corbin, 905-823-4881; 'CT-52' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com; '220NA' manufactured by National Guard Products, 800-647-7874 www.ngpinc.com; and distributed by K.M. Thomas 877-798-0611 www.kmthomas.com.

.63 Automatic door bottom(semi-recessed): operable and automatic door seal of aluminum frame and neoprene seal, automatic retract mechanism when door is open, listed and labelled for use in 90 min. fire doors, in accordance with ASTM E2074-00e1 and CAN4-S104-10.

.1 Acceptable material: '#362' manufactured by Zero International www.zerointernational.com, distributed by J.M.T. Phillips division of Yale-Corbin, 905-823-4881; 'CT-52' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com; '420NAHM' manufactured by National Guard Products, 800-647-7874 www.ngpinc.com; and distributed by K.M. Thomas 877-798-0611 www.kmthomas.com.

.64 Automatic door bottom (mortised): operable and automatic door seal of aluminum frame and neoprene seals, automatic retract mechanism when door is open, listed and labelled for use in 90 min. fire doors, in accordance with ASTM E2074-00e1 and CAN/ULC-S104-10.

.1 Acceptable material: '364A' manufactured by Zero International www.zerointernational.com, distributed by J.M.T. Phillips division of Yale-Corbin, 905-823-48811; 'CT-54' manufactured by K.N. Crowder 905-315-9788 or 800-567-0123 www.kncrowder.com; '520NA' manufactured by National Guard Products, 800-647-7874 www.ngpinc.com; and distributed by K.M. Thomas 416-798-0611 www.kmthomas.com.

.65 Door viewer: to ANSI/BHMA-A156.16-2013, type L13171, wide angle viewer prism, 12 mm diameter male/female threaded brass, 605.

.66 Door scope: 132° angle viewer, glass lenses and prisms, 50 mm diameter viewing aperture. [ABS plastic body,] [charcoal,] [grey,] [brown,] [Aluminum body,] [silver,] [gold,] Warnock Hersey fire tested for 1 hour wood doors.

.1 Acceptable material: 'DoorScope' distributed by Dunleavy Cordun Associates, 416-789-1999 www.dunleavycordun.com.

.67 Astragal: [1.2 mm thick cold rolled steel, finish 600,] [1.2 mm stainless steel, finish 630, satin,] 50 mm wide x length to suit door, mounted with [non-removable] [or protected screws], [[smoke] [weather] seal gasket].

.68 Offset security astragal: 4.8 mm thick steel, 64 mm wide, through bolt mounted, for out-swinging single doors, [6 mm radiused corners,] drill within 75 mm of door top and bottom and 800 mm oc maximum along its length, [zinc plated.] [gray primed.]

.69 Door coordinator: [surface] [concealed] for pair of doors with lapping astragal. Provide related components.

.70 Storm door closer: to ANSI/BHMA-A156.4-2013, type C09353, tubular pneumatic closer.

.71 Chain door stop: to ANSI/BHMA-A156.16-2013, type L02231.

.72 Power supply for exit device: ULC approved, rated for and compatible with [Electric Latch Retraction Exit Device] [Electric Strike].

.1 Acceptable material: 'Model MPB 842' manufactured by Von Duprin 905-278-6128 www.vonduprin.com, division of Ingersoll-Rand.

.73 Key switch for exit device: rated for and compatible with Exit Device[, latch bolt status indicator lights].

.1 Acceptable material: 'Model SS-903 1SL' manufactured by Von Duprin 905-278-6128 www.vonduprin.com.

.74 Removable mullion: [[stainless] [steel],] [aluminum] [key removable, mortise cylinder.]

.75 Door louvre: steel, 1.2 mm thick frame, 0.9 mm thick sight proof blades, tight mitered corners, no visible mounting holes on corridor side, [prime painted.] [[beige] [bronze] baked enamel.]

.76 Fire door grille: ULC listed and labelled, meeting requirements of Federal Fire Commissioner (FFC), CAN/ULC-S112-10 "Standard Method of Fire Test of Fire Damper Assemblies", rating as required by code for membrane being pierced, galvanized steel multi-blade type, 90° inverted V louvres, sight proof, frame with double flange 32 x 32 x 1.6 mm (16 guage) steel angle on full perimeter of frame on both sides of barrier being pierced, install in accordance with NFPA 90A-2015 and manufacturer's installation instructions, size: [459 x 306 mm (18"x12")]. Complete with thru bolts and one way vandal proof heads. Finish [white baked enamel] [_____].

.1 Acceptable material: 'Model 61DGD-FR, Fire Rated Door Grille (Louvre)', distributed by Nailor Industries Inc., 416-744-3300, www.nailor.com.

.77 Exit motion detector device: to Section 28 13 00.

.78 Door contact: to Section 28 13 00.

.79 Card reader: to Section 28 13 00.

Part 3 EXECUTION

3.1 HARDWARE SCHEDULE

.1 Refer to hardware schedule below:

Heading 01

1 PR Door H158-1 EXISTING / GENERAL PROCESSION
2/915 X 2286 X 45 X HMD X HMF X 45MIN

Each Assembly to have:

6	EA	HW HINGE	5BB1HW 114 X 114 NRP	652
1	SET	AUTO FLUSH BOLT	FB31P	630
1	EA	DUST PROOF STRIKE	DP1	626
1	EA	CLASSROOM LOCK	L9070P 03B	630
1	EA	COORDINATOR	COR X FL	628
2	EA	OH STOP	100S	630
2	EA	SURFACE CLOSER	4021	689
2	EA	MOUNTING PLATE	4020-18G	689
2	EA	KICK PLATE	8400 200MM X 25MM LDW B4E	630
1	EA	SMOKE SEAL	W-21 (2 H X 1 W)	BLK
1	EA	ASTRAGAL	W-25 (2 X H)	628

Heading 02

1 PR Door H158-2 GENERAL PROCESSING / INSTRUMENTATION AND ANALYSES
1 PR Door H158-3 CORRIDOR / GENERAL PROCESSION
2/915 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

6	EA	HINGE	5BB1 114 X 102 NRP	652
2	EA	MANUAL FLUSH BOLT	FB458	626
1	EA	DUST PROOF STRIKE	DP2	626
1	EA	CLASSROOM LOCK	L9070P 03B	630
2	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	4040XP EDA	689
2	EA	KICK PLATE	8400 200MM X 25MM LDW B4E	630

Heading 03

1 SGL Door H158C-1 CORRIDOR / ACID ROOM
914 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 114 X 102 NRP	652
1	EA	CLASSROOM LOCK	L9070P 03B	630
1	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	1461 EDA	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630

Heading 04

1 SGL Door H158D-1 CORRIDOR / EQUIPMENT ROOM
1016 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 127 X 114 NRP	652
1	EA	CLASSROOM LOCK	L9070P 03B	630
1	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	1461 DEL EDA	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630

Heading 05

1 SGL Door H158E-1 INSTRUMENTATION AND ANYLYSIS / PUMP ROOM
914 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 114 X 102	652
1	EA	STOREROOM LOCK	L9080P 03B	630
1	EA	OH STOP	90S	630
1	EA	SURFACE CLOSER	1461	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630

Heading 06

1 SGL Door H158F-1 INSTRUMENTATION AND ANYLYSIS / PUMP ROOM
914 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 114 X 102	652
1	EA	STOREROOM LOCK	L9080P 03B	630
1	EA	SURFACE CLOSER	1461	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630
1	EA	WALL STOP	WS406/407CVX	630

Heading 07

1 PR Door D-107 EXTERIOR / STORAGE
2/915 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

6	EA	HW HINGE	5BB1HW 114 X 114	630
2	EA	MANUAL FLUSH BOLT	FB458	626
1	EA	DUST PROOF STRIKE	DP1	626
1	EA	STOREROOM LOCK	L9080P 03B	630
2	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	4040XP ST-1630	689
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ	689
2	EA	KICK PLATE	8400 200MM X 25MM LDW B4E	630
1	EA	WEATHER STRIPPING	W-20S (HEAD) (1 X W)	628
1	EA	WEATHER STRIPPING	W-50S (JAMB) (2 X H)	628
1	EA	ASTRAGAL	W-8S (1 X H)	600
2	EA	DOOR SWEEP	W-24S (1 X W)	628
1	EA	THRESHOLD	CT-45 (1 X W)	627
2	EA	DOOR CONTACT	679-05HM	BLK

Heading 08

1 SGL Door L527-1 EXISTING / LAB
1 SGL Door L530-1 EXISTING / LAB
1016 X 2440 X 45 X ALD X ALF X NONRTD

Each Assembly to have:

1	EA	CONT. HINGE	112HD	628
1	EA	DEADBOLT	TD1850	628
1	EA	MORTISE CYLINDER	20-013	626
1	EA	MORTISE THUMBTURN	TT1025	628
1	SET	90 DEG OFFSET PULL	PR 8190HD N	630
1	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	4021	689
1	EA	MOUNTING PLATE	4020-18G	689

Heading 09

1 SGL Door ST530-1 CORRIDOR / FREEZE DRIER ROOM
1016 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HW HINGE	5BB1HW 127 X 114 NRP	652
1	EA	CLASSROOM LOCK	L9070P 03B	630
1	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	4040XP EDA	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630
1	EA	WEATHER STRIPPING	W-50S (2 H X 1 W)	628
1	EA	DOOR BOTTOM	CT-52 (1 X W)	627

Heading 10

1 SGL Door L530A-1 LAB / ANALYSIS ROOM
914 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 114 X 102 NRP	652
1	EA	CLASSROOM LOCK	L9070P 03B	630
1	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	1461 EDA	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630

Heading 11

1 SGL Door D-101 MECHANICAL PENTHOUSE / NEW PENTHOUSE
914 X 2286 X 45 X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 114 X 102	652
1	EA	PASSAGE SET	L9010 03B	630
1	EA	OH STOP	100S	630
1	EA	SURFACE CLOSER	1461 EDA	689
1	EA	KICK PLATE	8400 200MM X 40MM LDW B4E	630

Heading 12

1 SGL Door O526-1 CORRIDOR / UNDESIGNATED SUPPORT ROOM
1 SGL Door O528-1 CORRIDOR / MEETING ROOM
1 SGL Door O532-1 CORRIDOR / QUIET ROOM
1 SGL Door O532A-1 CORRIDOR / QUIET ROOM
1016 X 2438 X 45 X ALD X ALF X NONRTD

Each Assembly to have:

1	EA	HARDWARE	ALL HARDWARE BY SLIDING DOOR MANUFACTURER

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 08 11 00 - Metal Doors And Frames

.2 Section 08 11 16 - Aluminum Doors And Frames

1.2 REFERENCES

.1 ASTM International

.1 ASTM C542-05(2011), Standard Specification for Lock-Strip Gaskets.

.2 ASTM D790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.3 ASTM D1003-13, Standard Test Method for Haze and Luminous Transmittance of Plastics.

.4 ASTM D1929-13a, Standard Test Method for Determining Ignition Temperature of Plastics.

.5 ASTM D2240-05(2010), Standard Test Method for Rubber Property - Durometer Hardness.

.6 ASTM E84-14, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.

.2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass.

.3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.

.3 Environmental Choice Program (ECP)

.1 CCD-045-95(R2005), Sealants and Caulking Compounds.

.4 Glass Association of North American (GANA)

.1 GANA Glazing Manual 50th Anniversary Edition-2008.

.2 GANA Laminated Glazing Reference Manual - 2009.

.3 GANA Sealant Manual-2008.

.4 GANA Laminated Glazing Reference Manual (2009).

.5 GANA Guide to Architectural Glass (2010).

.6 GANA/PGC International Protective Glazing Manual (2010).

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Arrange for site visit with Departmental Representative prior to start of Work to examine existing site conditions adjacent to demolition Work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories 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 Ontario, Canada.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Submit 300 mm x 300 mm size samples of glass types.

.5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect glazing and frames from nicks, scratches, and blemishes.

.3 Protect prefinished aluminum surfaces with wrapping or strippable coating.

.4 Replace defective or damaged materials with new.

1.8 AMBIENT CONDITIONS

.1 Ambient Requirements:

.1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Design Criteria:

.1 Size glass to withstand wind loads, dead loads and positive and negative live loads to ASTM E330.

.2 Limit glass deflection to 1/200 with full recovery of glazing materials.

.2 Flat Glass:

.1 Float glass: to CAN/CGSB-12.3, minimum 6 mm thick.

.2 Safety glass: to CAN/CGSB-12.1, transparent, minimum 6 mm thick.

.1 Type 2-tempered.

.2 Class B-float.

.3 Category II – fully tempered.

.3 Sealant: in accordance with Section 07 92 00.

2.2 ACCESSORIES

.1 Setting blocks: silicone, 90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.

.2 Spacer shims: silicone, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.

.3 Glazing tape:

.1 100% polybutalene vehicle. Extruded in ribbon form with paper separator. Tape shall have an integral shim strip where required; black colour.

.4 Glazing splines: resilient silicone, extruded shape to suit glazing channel retaining slot, colour black.

.5 Lock-strip gaskets: to ASTM C542.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

.3 Visually inspect substrate in presence of Departmental Representative.

.4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION: INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

.1 Perform work in accordance with GANA Glazing Manual for glazing installation methods and with GANA Sealant Manual.

.2 Cut glazing tape to length and install against permanent stops, projecting 1.6 mm above sight line.

.3 Place setting blocks at ¼ points, with edge block maximum 150 mm from corners.

.4 Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of light or unit.

.5 Install removable stops, with spacer shims inserted between glazing and applied stops at 600 mm intervals, 6 mm below sight line.

.6 Fill gaps between light and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.

.7 Trim protruding tape edge.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.1 Remove traces of primer, caulking.

.2 Remove glazing materials from finish surfaces.

.3 Remove labels.

.4 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 After installation, mark each light with an "X" by using removable plastic tape or paste.

.1 Do not mark heat absorbing or reflective glass units.

.3 Repair damage to adjacent materials caused by glazing installation.

3.6 SCHEDULE

.1 Aluminum Doors and Frames:

.1 Single 6 mm clear tempered safety glazed light, as indicated.

.2 Hollow Metal Doors and Borrowed Lights:

.1 Single 6 mm clear tempered safety glazed light, as indicated.

SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 22 00 - Concrete Unit Masonry

.2 Section 07 92 00 - Joint Sealants

.3 Section 08 11 00 - Metal Doors and Frames

.4 Section 08 11 16 - Aluminum Doors and Frames

.5 Section 09 91 23 - Interior Painting

1.2 REFERENCES

.1 ASTM International

.1 ASTM C473-12, Standard Test Methods for Physical Testing of Gypsum Panel Products.

.2 ASTM C475/C475M-12, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.3 ASTM C514-04(2009)e1, Standard Specification for Nails for the Application of Gypsum Board.

.4 ASTM C754-11, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

.5 ASTM C840-13, Standard Specification for Application and Finishing of Gypsum Board.

.6 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.

.7 ASTM C1002-07(2013), Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.8 ASTM C1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.9 ASTM C1396/C1396M-14, Standard Specification for Gypsum Board.

.10 ASTM E90-09 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.11 ASTM E2638-10 Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.

.2 Association of the Wall and Ceilings Industries International (AWCI)

.1 AWCI Levels of Gypsum Board Finish 101a-97.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

.4 Canadian Standards Association (CSA):

.1 CSA S136-12, North American Specification for the Design of Cold-Formed Steel Structural Members and Commentary

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DESIGN REQUIREMENTS

.1 Partition assembly to be fire resistance rated.

.2 Minimum sound transmission rating of installed panel partition to be STC 30, tested to ASTM E90.

.3 Minimum speech privacy category SPC Standard Speech Privacy 60-65, tested to ASTM E2638.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 gypsum board assemblies materials level, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board products from nicks, scratches, and blemishes.

.3 Protect from weather, elements and damage from construction operations.

.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.5 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

.6 Replace defective or damaged materials with new.

1.6 AMBIENT CONDITIONS

.1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Standard board: to ASTM C1396/C1396M having mould resistant facers meeting a rating of 10 (zero mould growth) in accordance with ASTM D3273, minimum 40% recycled content, regular, 15.9 mm thick and fire-rated, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

.2 Non-load bearing channel stud framing: to ASTM C645, stud size as indicated on Drawings, roll formed from 0.53 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres. Steel: minimum 25% recycled content.

.1 Use 0.91 mm thickness stud framing to support fire rated door frames.

.3 Shaft Wall Framing System: to ASTM C645, manufacturer's standard shaft wall steel framing system (C-H, I or C-T shapes) having ASTM A653/A653M, Z180, hot-dip galvanized zinc coating; minimum steel thickness of 0.46 mm thick or heavier as required by detailed design requirements listed in this Section for indicated spans; including head and bottom rails, channels, trim and accessories required for a complete installation.

.4 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height. Steel: minimum 25% recycled content.

.5 Slotted Deflection Track: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm on centre along length of runner; tested and certified for use in fire rated wall construction and have a ULC or $_{C}UL_{US}$ labelled assembly for fire rated assemblies.

.6 Metal channel stiffener: 19 x 38 mm size, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating, minimum 25% recycled content.

.7 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.8 Resilient clips: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.9 Nails: to ASTM C514.

.10 Steel drill screws: to ASTM C1002.

.11 Stud adhesive: to CAN/CGSB-71.25.

.12 Laminating compound: as recommended by manufacturer, asbestos-free.

.13 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, Zinc, 0.5 mm base thickness, perforated flanges, one piece length per location.

.14 Sealants: in accordance with Section 07 92 00.

.1 Acoustic sealant: in accordance with Section 07 92 00.

.15 Polyethylene: to CAN/CGSB-51.34, Type 2.

.16 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

.17 Joint compound: to ASTM C475/C475M, asbestos-free.

.18 Joint tape: to ASTM C475/C475M.

.1 Paper tape for standard gypsum board.

.2 Glass mesh tape for impact resistant gypsum board.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies 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 STEEL STUD FRAMING INSTALLATION

.1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.

.2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.

.3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

.4 Place studs vertically at centres indicated on Drawings and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.5 Erect metal studding to tolerance of 1:1000.

.6 Attach studs to bottom and ceiling track using screws.

.7 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.10 Erect track at head of door openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above openings in same manner and spacing as wall studs.

.11 Frame openings and around built-in equipment, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.12 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.13 Extend partitions to ceiling height except where noted otherwise on drawings.

.14 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use Slotted Deflection Track.

.15 Install continuous insulating strips to isolate studs from uninsulated surfaces.

3.3 FURRING INSTALLATION

.1 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.

.2 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.3 Install work level to tolerance of 1:1200.

.4 Frame perimeter of openings for access panels, light fixtures, diffusers and grilles.

.5 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.6 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.

.7 Furr beams, columns, pipes and exposed services where indicated.

3.4 ACCESSORIES INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Locate control joints where indicated and at changes in substrate construction.

.8 Install control joints straight and true.

.9 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.

.10 Install expansion joint straight and true.

.11 Splice corners and intersections together and secure to each member with 3 screws.

.12 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

3.5 GYPSUM BOARD INSTALLATION AND FINISHING

.1 Do installation and finishing of gypsum board to ASTM C840 except where specified otherwise.

.2 Apply gypsum board after bucks, anchors, blocking, electrical and mechanical work have been reviewed.

.3 Apply single or double layer gypsum board to metal furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.

.2 Apply gypsum board vertically unless indicated otherwise. If horizontal is required, provide sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.4 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.5 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.6 Install gypsum board with face side out.

.7 Do not install damaged or damp boards.

.8 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

.9 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 0: no tapping, finishing or accessories required.

.2 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.

.3 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.

.4 Level 3: embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.5 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.6 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.

.10 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.11 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.12 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.13 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.14 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.15 Mix joint compound slightly thinner than for joint taping.

.16 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

.17 Allow skim coat to dry completely.

.18 Remove ridges by light sanding or wiping with damp cloth.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 gypsum board assemblies installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)

.1 ANSI A108.1- 2013, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).

.2 CTI A118.3-2013, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1).

.3 CTI A118.4-2013, Specification for Latex Cement Mortar (included in ANSI A108.1).

.4 CTI A118.5-2013, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1).

.5 CTI A118.6-2013, Specification for Ceramic Tile Grouts (included in ANSI A108.1).

.2 American Society for Testing and Materials International (ASTM)

.1 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 A123.3-05(R2010), Asphalt Saturated Organic Roofing Felt.

.2 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.5 Terrazzo, Tile and Marble Association of Canada (TTMAC):

.1 Tile Specification Guide 09 30 00 2012/2013, Tile Installation Manual.

.2 Tile Maintenance Guide 2000.

1.2 SUBMITTALS

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

.2 Provide product data in accordance with Section 01 33 00.

.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).

.3 Divider strip.

.4 Elastomeric membrane and bond coat.

.5 Reinforcing tape.

.6 Levelling compound.

.3 Provide samples in accordance with Section 01 33 00.

.1 Base tile: submit duplicate, 300 x 300 mm sample panels of each colour, texture, size, and pattern of tile.

.2 Floor tile: submit duplicate, 300 x 300 mm sample panels of each colour, texture, size, and pattern of tile.

.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.

1.3 QUALITY ASSURANCE

.1 Quality Assurance Submittals:

.1 Manufacturer's Instructions: manufacturer's installation instructions.

.2 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.5 AMBIENT CONDITIONS

.1 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.

.2 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.

.3 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.

.3 Maintenance material same production run as installed material.

Part 2 PRODUCTS

2.1 FLOOR TILE

.1 Porcelain tile: to CAN/CGSB-75.1, Type 4, Class MR 2, CR 1, 10 x 300 x 300 mm size, cushion edges, porcelain with abrasive admixture and slip resistant surface, colour as selected by Departmental Representative. Matching coved base, 300 x 100 mm high.

2.2 WALL TILE

.1 Ceramic tile: to CAN/CGSB-75.1, Type 5 Class MR 2, CR 1, 8 x 300 x 300 mm size, cushion edges, matt glazed surface, colour as selected by Departmental Representative. Matching bullnose edge trim to suit application.

2.3 BASE TILE

.1 Base: coved; type, size, colour and texture and properties to match adjacent flooring material.

2.4 TRIM SHAPES

.1 Conform to applicable requirements of adjoining floor and wall tile.

.2 Use slip resistant trim shapes for horizontal surfaces.

.3 Use trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise.

.4 Internal and External Corners: provide trim shapes as follows where indicated.

.1 Bullnose shapes for external corners including edges.

.2 Coved shapes for internal corners.

.3 Special shapes for:

.1 Base to floor internal corners to provide integral coved vertical and horizontal joint.

.2 Base to floor external corners to provide bullnose vertical edge with integral coved horizontal joint. Use as stop at bottom of openings having bullnose return to wall.

2.5 MORTAR MATERIALS

.1 Primer: Low VOC, low viscosity primer as recommended by manufacturer to suit substrate and site conditions; provide proof of bonding ability of setting system where manufacturer recommends that a primer is not necessary to installation.

.2 Rapid Setting Mortar: Dry set mortar meeting or exceeding the requirements of ASTM C627 for Extra Heavy installation using rapid curing, latex modified, portland cement mortar meeting requirements of ANSI A108.1.

.3 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.

2.6 BOND COAT

.1 Epoxy bond coat: non-toxic, non-flammable, non-hazardous during storage, mixing, application, and when cured. To produce shock and chemical resistant mortars having the following physical characteristics:

- .1 Compressive Strength: 246 kg/cm^2.
- .2 Bond Strength: 53 kg/cm^2.
- .3 Water Absorption: 4.0% Max.
- .4 Ozone Resistance, 200 hours @ 200 ppm: no loss of strength.
- .5 Smoke Contribution Factor: 0.
- .6 Flame Contribution Factor: 0.
- .7 Finished mortar and grout to be resistant to urine, dilute acid, dilute alkali, sugar, brine and food waste products, petroleum distillates, oil and aromatic solvents.
- .8 Bond Coat: maximum VOC limit 65 g/L.

.2 Chemical-Resistant Bond Coat:

- .1 Epoxy Resin Type: CTI A118.3.
- .2 Furan Resin Type: CTI A118.5.
- .3 Bond Coat: maximum VOC limit 65 g/L

2.7 GROUT

.1 Colouring Pigments:

- .1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979/C979M.
- .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 Chemical-Resistant Grout:

- .1 Epoxy grout: to ANSI A108.1, having quality, colour and characteristics to match epoxy bond coat. Adhesive and grout by same manufacturer.
- .2 Furan grout: to CTI A118.5.

2.8 ACCESSORIES

.1 Straight Edge Strips: Roll formed stainless steel edge strips, 3 mm wide at top edge; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material.

.2 Transition Edge Strips: Extruded brushed stainless steel edge strips; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material.

.3 Sealant: in accordance with Section 07 92 00.

- .1 Sealants: maximum VOC limit 250 g/L.

.4 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers and as follows:

.1 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner manufacturers recommendations and as recommended by tile manufacturer.

.2 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with manufacturer’s recommendations.

2.9 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 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.

.4 Ready for use in 48 hours after application.

2.10 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 WORKMANSHIP

.1 Do tile work in accordance with TTMAC Tile Installation Manual 2012/2013, "Ceramic Tile", except where specified otherwise.

.2 Apply tile to clean and sound surfaces.

.3 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.

.4 Maximum surface tolerance 1:800.

.5 Make joints between tile uniform and approximately 3.0 mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.

.6 Lay out tiles so perimeter tiles are minimum 1/2 size.

.7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

.8 Make internal angles square, external angles bullnosed.

.9 Use bullnose edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.

.10 Install divider strips at junction of tile flooring and dissimilar materials.

.11 Allow minimum 24 hours after installation of tiles, before grouting.

.12 Clean installed tile surfaces after installation and grouting cured.

.13 Make control joints at 3 m in each direction. Make joint width same as tile joints. Fill control joints with sealant in accordance with Section 07 92 00. Keep building expansion joints free of mortar and grout.

3.3 WALL TILE

.1 Install in accordance with TTMAC detail 305W.

3.4 FLOOR TILE

.1 Install in accordance with TTMAC detail 311F, Detail B.

3.5 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.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM E1264-08e1, Standard Classification for Acoustical Ceiling Products.

.2 ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

.2 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.

.3 Canadian Standards Association (CSA)

.1 CSA B111-74(R1998), Wire Nails, Spikes and Staples.

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials.

1.2 SAMPLES

.1 Submit samples in accordance with Section 01 33 00.

.2 Submit duplicate full size samples of each type acoustical units.

1.3 REGULATORY REQUIREMENTS

.1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.4 QUALITY ASSURANCE

.1 Minimum speech privacy category SPC Standard Speech Privacy 60-65 tested to ASTM E2638.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Permit wet work to dry before commencement of installation.

.2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.

.3 Store materials in work area 48 hours prior to installation.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1.

- .1 Type XII.
- .2 Glass fibre with minimum 35% recycled content.
- .3 Pattern no pattern.
- .4 Flame spread rating of Class A or less in accordance with CAN/ULC-S102.
- .5 Smoke developed 50 or less in accordance with CAN/ULC-S102.
- .6 Noise reduction coefficient (NRC) designation of 0.95.
- .7 Ceiling Attenuation Class (CAC) rating N/A, in accordance with ASTM E1264
- .8 Light reflectance range of 0.86.
- .9 Edge type square.
- .10 Colour white.
- .11 Size 609 x 1219 x 25 mm thick.
- .12 Shape panel.
- .13 Alloy designation for stainless steel pans 302.
- .14 Surface finish of aluminum panels anodized.
- .15 Surface coverings: factory applied latex paint.

.2 Adhesive: low VOC type recommended by acoustic unit manufacturer.

.3 Staples, nails and screws: to CSA B111 non-corrosive finish as recommended by acoustic unit manufacturer.

.4 Polyethylene: to CAN/CGSB-51.34, 0.15 mm thick.

.5 Hold down clips: purpose made clips to secure tile to suspension system, approved for use in fire-rated systems.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.

3.2 INSTALLATION

.1 Install acoustical panels and tiles in ceiling suspension system.

.2 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

3.3 INTERFACE WITH OTHER WORK

.1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International

.1 ASTM C635/C635M-13, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

.2 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

.3 ASTM E580/E580M-11b, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

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

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension 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 Ontario, Canada.

.2 Submit reflected ceiling plans for special grid patterns as indicated.

.3 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, change in level details, access door dimensions, and locations and acoustical unit support at ceiling fixture.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit one representative model of ceiling suspension system.

.4 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for acoustical suspension for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect acoustical ceiling tiles and tracks 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 and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Design Requirements: maximum deflection: 1/360th of span to ASTM C635/C635M deflection test.

2.2 MATERIALS

.1 Intermediate duty system to ASTM C635/C635M.

.2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.

.3 Suspension system: non fire rated, made up as follows:

.1 2 directional exposed tee bar grid.

.2 Concealed tee access spline.

.4 Exposed tee bar grid components: shop painted satin sheen, white colour. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.

.5 Hanger wire: galvanized soft annealed steel wire:

.1 3.6 mm diameter for access tile ceilings.

.6 Hanger inserts: purpose made.

.7 Carrying channels: 38mm galvanized steel, as recommended by acoustic unit manufacturer.

.8 Accessories: splices, clips, wire ties, retainers and wall moulding flush, to complement suspension system components, as recommended by system manufacturer.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track 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 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Installation: to ASTM C636/C636M except where specified otherwise.

.3 Do not erect ceiling suspension system until work above ceiling has been inspected and approved by Departmental Representative.

.4 Secure hangers to overhead structure using attachment methods acceptable to Departmental Representative.

.5 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.

.6 Lay out system according to reflected ceiling plan.

.7 Ensure suspension system is co-ordinated with location of related components.

.8 Install wall moulding to provide correct ceiling height.

.9 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers and grilles.

.10 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.11 Interlock cross member to main runner to provide rigid assembly.

.12 Frame at openings for light fixtures, air diffusers and at changes in ceiling heights.

.13 Install access splines to provide 10% ceiling access.

.14 Finished ceiling system to be square with adjoining walls and level within 1:1000.

.15 Expansion joints:

.1 Supply and install "Z" shaped metal trim pieces at each side of expansion joint. Design to accommodate plus or minus 25 mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by acoustical suspension installation.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 41 99 –Demolition: Removal of existing floor finishes ready for work of this

.2 Section 08 71 00 – Door Hardware: Stainless Steel threshold at fire rated doors with combustible floor finishes.

.3 Section 09 30 13 – Ceramic Tiling

.4 Section 09 68 13 – Tile Carpeting

.5 Division 22 – Mechanical: Floor Drains.

.6 Division 26 – Electrical: Floor mounted accessories.

1.2 REFERENCES

.1 ASTM International (ASTM)

.1 ASTM F150-06, Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring

.2 ASTM F1303-04(2014), Standard Specification for Sheet Vinyl Floor Covering with Backing.

.2 National Fire Protection Association (NFPA):

.1 NFPA 255-2006, Standard Method of Test of Surface Burning Characteristics of Building Materials

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Close spaces to traffic during flooring installation and until time period after installation recommended in writing by manufacturer; install flooring and accessories after other finishing operations, including painting and ceiling construction have been completed and as follows:

.1 Work of this Section includes floor levelling and patching required to meet resilient flooring manufacturer’s installation requirements; Coordinate where differences occur between manufacturer’s requirements and actual conditions.

.2 Coordinate installation of prefabricated integral cove bases with resilient flooring installation.

.3 Install flooring before laboratory millwork and other surface mounted fixtures are installed.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for resilient sheet flooring and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base, edge strips.

.2 Prefabricated Integral Cove Base: Submit duplicate 100 mm x 100 mm samples of bases representative of colour, pattern, riser height and toe lengths specified. Samples shall represent one completed inside corner and one completed outside corner, with seams sealed and finished.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide 5% of total installation with a minimum of 3000 mm length and large remnants of each colour and type for project for maintenance use.

.3 Extra materials one piece and from same production run as installed materials.

.4 Identify each roll of sheet flooring and each container of adhesive.

.5 Prefabricated Integral Cove Base: 5% of total installation with a minimum of 3000 mm of each colour and type

.6 Resilient Base and Accessories: 5% of total installation with a minimum of 2400 mm length of each colour and type

.7 Deliver to Departmental Representative, upon completion of the work of this section.

.8 Store where directed by Departmental Representative.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Prefabricated Cove Bases: Deliver prefabricated integral cove bases in accordance with manufacturer’s written instructions; store flat on clean, dry floor area, away from construction activities to prevent damage.

.4 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21.

1.7 SITE CONDITIONS

.1 Ambient Conditions:

.1 Maintain air temperature and structural base temperature at flooring installation area above 20 degrees for 48 hours before, during and 48 hours after installation.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Unbacked Sheet Vinyl Flooring: Homogenous sheet vinyl with a polyurethane coating conforming to ASTM F1913, Type II and the following:

.1 Classification: Commercial

.2 Wear Layer: Clear UV cured polyurethane

.3 Fire Performance: CAN/ULC S 102.2

.1 Flame Spread: 100 or less.

.2 Smoke Developed: < 300.

.4 Static Dissipation Range: having a resistance of 1.0 X 106 to 1.0 X 109 ohms in accordance with ASTM F150.

.5 Colour: selected by Departmental Representative

.6 Pattern: Smooth

.7 Total Thickness: nominal 2 mm

.8 Width: minimum nominal 2000 mm

.9 Length: Manufacturers standard roll length

.2 Prefabricated Integral Cove Base: Fabricated from same materials and dye lots as resilient flooring, in maximum practical lengths, with 38 mm x 38 mm formed aluminum reinforcing bonded to back of base material.

.1 Riser: 100 mm

.2 Toe: 75 mm

.3 Metal Base Cap: Adhesive installation; stainless steel cap as recommended by manufacturer.

.3 Resilient base: continuous, top set, complete with premoulded end stops and external corners:

.1 Type: rubber.

.2 Style: cove.

.3 Thickness: 3.17 mm.

.4 Height: 101.6 mm.

.5 Lengths: cut lengths minimum 2400 mm.

.6 Colour: selected by Departmental Representative.

.4 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade and as follows:

.1 Adhesives: Solvent free, water resistant primer and adhesive as recommended by flooring or resilient accessory manufacturer to suit resilient products specified and substrate materials and conditions maximum VOC limit 50 g/L, and as follows:

.1 Flooring Adhesive: Light bodied adhesive recommended by flooring manufacturer

.2 Prefabricated Integral Cove Base Adhesive: Low-VOC premium cove base adhesive as recommended by prefabricated cove base manufacturer.

.5 Sub-floor filler and leveller: Latex modified, portland cement based formulation provided or approved by resilient product manufacturer for applications indicated; Gypsum based materials will not be accepted for use on this project.

.6 Chemical Bonding Compound: Product of flooring manufacturer for chemically bonding seams.

.7 Metal edge strips:

.1 Stainless steel, smooth, polished with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.8 External corner protectors: stainless steel, type recommended by flooring manufacturer.

.9 Edging to floor penetrations: stainless steel type recommended by flooring manufacturer.

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 resilient sheet flooring 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 SITE VERIFICATION OF CONDITIONS

.1 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.3 PREPARATION

.1 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives.

.2 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.

.3 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.4 Provide a leveling coat over the entire sub-floor.

.5 Prime concrete slab to resilient flooring manufacturer's printed instructions.

3.4 APPLICATION: FLOORING

.1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least two weeks following building occupation.

.2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.3 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.

.4 Run sheets in direction of traffic. Heat weld according to manufacturer's printed instructions.

.5 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.

.6 Cut flooring around fixed objects.

.7 Continue flooring over areas which will be under built-in furniture.

.8 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.9 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.

.10 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 APPLICATION: PREFABRICATED INTEGRAL COVE BASE:

.1 Provide prefabricated cove base for all integral base as indicated.

.2 Dry fit base; cut and fit material to required lengths; mitre cut inside and outside corners.

.3 Dry-fit, and cut metal cover cap prior to base installation.

.4 Scribe glue line on walls and floor at edge of base material.

.5 Apply adhesive in full spread (100% coverage on two surfaces) for full length of base material. Apply base to wall surface straight and level.

.6 Slide cove cap behind base material.

.7 Hand roll base material onto wall and floor surface, and remove all bumps, ripples, and fish mouths. Remove all excess adhesive.

.8 Seam seal all seams (vertical and horizontal) in base material.

3.6 APPLICATION: COVE BASE

.1 Lay out base to keep number of joints at minimum.

.2 Clean substrate and prime with one coat of adhesive.

.3 Apply adhesive to back of base.

.4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.

.5 Install straight and level to variation of 1:1000.

.6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.

.7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.

.8 Heat weld base in accordance with manufacturer's printed instructions.

3.7 APPLICATION: COVE BASE

.1 Lay out base to keep number of joints at minimum.

.2 Clean substrate and prime with one coat of adhesive.

.3 Apply adhesive to back of base.

.4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.

.5 Install straight and level to variation of 1:1000.

.6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.

.7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.

.8 Heat weld base in accordance with manufacturer's printed instructions.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.1 Clean flooring and base] surfaces to flooring manufacturer's printed instructions.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

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

3.9 PROTECTION

.1 Protect new floors from time of final set of adhesive until final inspection.

.2 Prohibit traffic on floor for 48 hours after installation.

3.10 SCHEDULES

.1 Floor Type F1: Where indicated on drawings; provide integral cove base.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 02 41 99 –Demolition: Removal of existing floor finishes ready for work of this Section

.2 Division 22 – Mechanical: Floor Drains.

.3 Division 26 – Electrical: Floor mounted accessories.

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D570-98(2010) e1, Standard Test Method for Water Absorption of Plastics

.2 ASTM D638-10, Standard Test Method for Tensile Properties of Plastics.

.3 ASTM D648-07, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

.4 ASTM D790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.5 ASTM D2369-10e1, Standard Test Method for Volatile Content of Coatings.

.6 ASTM D4060-10, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

.7 ASTM D4541-09e1, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.2 International Concrete Repair Institute (IRCI)

.1 ICRI Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, coatings and Polymer Overlays.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Close spaces to traffic during flooring installation and until time period after installation recommended in writing by manufacturer:

.1 Work of this Section includes floor levelling and patching required to meet resinous flooring manufacturer's installation requirements; Coordinate where differences occur between manufacturer's requirements and actual conditions.

.2 Coordinate installation of cove bases with resinous flooring installation.

.3 Install flooring before surface mounted fixtures are installed.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for resilient sheet flooring and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit duplicate 400 x 200 mm samples of each colour and finish coating applied to hardboard.

1.5 QUALIFICATIONS

.1 Applied by applicator trained and licensed by epoxy material manufacturer for application of its products.

.2 Manufacturer's representative:

.1 Inspect substrate prior to commencement of work, during application of materials and upon completion of work.

.2 Provide technical assistance to the applicator and assist where required in correct installation of expansion joint filler, floor base cove mortar and floor epoxy resinous flooring system.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not apply epoxy systems unless uniform minimum 16°C air temperature at installation area for 24 hours prior to and after application.

.2 Provide adequate ventilation or isolation measures to protect against toxic fumes.

.1 Ventilate area 24 hours per day, during installation and for 7 days after installation is completed with minimum 30% outside air.

.2 Ventilate at a rate sufficient to produce a negative pressure in the work area [and exhaust direct to the outside of the building. Do not recirculate contaminants within the building.

1.7 MAINTENANCE DATA

.1 Provide maintenance data for coatings for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.1 Submit manufacturer's printed maintenance instructions for repair, cleaning and maintenance procedures; include name of original installer and contact information.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Ensure compatibility for all epoxy materials including primers, resins, hardening agents, finish coats and sealer coats.

.2 All epoxy materials from same manufacturer.

2.2 EXPANSION AND CONTROL JOINT FILLER

.1 Joint filler: self leveling, two-component sealant based on a flexible epoxy resin and a blended polyamide curing agent, 100% solids as recommended by manufacturer.

2.3 FLOOR SYSTEM NOVALAC EPOXY WITH EPOXY MORTAR COVE BASE

.1 Floor system: Two-component, high solids, epoxy-Novolac coating with integral epoxy coves.

.1 VOC Content: ≤ 45 g/L in accordance with ASTM D2369.

.2 System Thickness: minimum 1.0 mm (40 mils)

.2 Floor Base (Cove) Mortar: three-component, solid colour, low VOC, vertical grade coving and detailing mortar with primer as recommended by manufacturer.

.1 Acceptable material: Sikafloor Morritex Epoxy Cove Mortar manufactured by SIKA Canada Inc., (514) 697-2610 www.sika.ca.

.3 Primer: Two component, clear, high solids, low VOC, moisture-tolerant epoxy primer and binder as recommended by manufacturer.

.1 Acceptable material: Sikagard WDE Primer manufactured by SIKA Canada Inc., (514) 697-2610 www.sika.ca

.4 Body (First) coat: 2 part Novalac epoxy, 95% solids, solid colour, colour selected by Departmental Representative to match floor base coat mortar.

.1 Acceptable material: Sikagard Duochem 7500 manufactured by SIKA Canada Inc., (514) 697-2610 www.sika.ca.

.5 Top (Second) coat: 2 part Novalac epoxy, 95% solids, solid colour, colour selected by Departmental Representative to match floor base coat mortar.

.1 Compressive strength: 57.8 MPa (8,380 psi) at 28 days in accordance with ASTM D695.

.2 Tensile strength: 20.4 MPa (2,960 psi) in accordance with ASTM D638 Type IV.

.3 Elongation at Break: 28% in accordance with ASTM D638 Type IV.

.4 Water Absorption: 24hrs-0.42%, 7 days-1.02% in accordance with ASTM D570.

.5 Water Vapour Transmission: 0.19 g/hr/m2 (30 mils) (water method) in accordance with ASTM E 96.

.6 Abrasion Resistance: 170 mg in accordance with ASTM D4060. (CS17/1000cycles/1000g)

.7 Acceptable material: Sikagard Duochem 7500 manufactured by Sika Canada Inc., (514) 697-2610 www.sika.ca.

2.4 MIXES

.1 Mix expansion joint filler, floor base coat mortar and top coat sealer in accordance with manufacturer's written instructions.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Examine substrates and conditions under which high performance coatings will be applied for acceptability in accordance with coating manufacturer's application requirements, and as follows:

.1 Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.

.2 Start of application is construed as Applicator's acceptance of surfaces within that particular area.

.2 Coordinate requirements of substrates to which primers or other coatings are being applied to ensure compatibility of total systems; provide information on characteristics of specified finish materials to indicate compatibility when requested:

.1 Obtain the following primer information before proceeding if a potential incompatibility exists:

.1 Confirmation of primer's suitability for expected service conditions.

.2 Confirmation of primer's ability being top coated with materials specified.

.2 Notify Consultant about anticipated problems before using the coatings specified over substrates primed by others.

3.2 SITE VERIFICATION OF CONDITIONS

.1 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.3 PREPARATION OF SURFACES

.1 Prepare surfaces in accordance with manufacturer's instructions.

.2 Clean substrates of substances that could impair bond of coatings before applying high performance coatings; remove oil and grease before cleaning.

.3 Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

.4 Clean and prepare surfaces being coated in accordance with manufacturer's written instructions for each substrate condition and as specified and as follows:

.1 Provide barrier coats over incompatible primers or remove primers and re-prime substrate.

.2 Prepare concrete being coated; remove efflorescence, chalk, dust, dirt, grease, oils, and release agents; roughen as required to remove glaze; use mechanical methods to prepare surfaces if hardeners or sealers have been used to improve curing, and as follows:

.1 Provide CSP level in accordance with ICRI Guideline No. 310-2R and manufacturer's written recommendation.

.2 Use abrasive blast cleaning methods recommended by coating manufacturer.

.3 Determine alkalinity and moisture content of surfaces by performing appropriate tests; correct this condition before application if surfaces are sufficiently alkaline to cause the finish paint to blister and burn; do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

.5 Mask surrounding surfaces to provide neat, clean juncture lines.

.6 Protect adjacent surfaces and equipment from damage by overspray.

.7 Complete work penetrating substrate before installing coating.

3.4 FLOOR SYSTEM APPLICATION

.1 Mix in accordance with material manufacturer's instructions.

.2 Trowel apply epoxy cove in accordance with manufacturer's written instructions.

.3 Apply primer to concrete and epoxy mortar in accordance with manufacturer's written instructions.

.4 Apply body and top coat in accordance with manufacturer's written instructions.

.5 Apply to floors in Rooms H 158.

.6 Co-ordinate with room finish schedule.

3.5 TESTING

.1 Perform two pull-off strength adhesion tests per floor area.

.2 Do pull-off strength adhesion tests in accordance with ASTM D4541-09e1.

.3 Patch floors where pull-off strength adhesion tests are performed. Patch shall not be visible when viewed 600 mm above finished floor.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Association of Textile Chemists and Colorists (AATCC)

- .1 AATCC Test Method 16-2004, Colorfastness to Light.
- .2 AATCC Test Method 23-2005, Colorfastness to Burn Gas Fumes.
- .3 AATCC Test Method 129-2005, Colourfastness to Ozone in the Atmosphere Under High Humidities.
- .4 AATCC Test Method 134-2006, Electrostatic Propensity of Carpets.
- .5 AATCC Test Method 171-2005, Carpets: Cleaning of; Hot Water Extraction Method.
- .6 AATCC Test Method 175-2008, Stain Resistance: Pile Floor Coverings.
- .7 AATCC Test Method 189-2007, Fluorine Content of Carpet Fibers.

.2 ASTM International

- .1 ASTM D297-13, Standard Test Methods for Rubber Products-Chemical Analysis.
- .2 ASTM D1335-12, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
- .3 ASTM D2661-11, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
- .4 ASTM D1667-05(2011), Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
- .5 ASTM D3574-11, Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.
- .6 ASTM D3936-12, Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-4.2 No. 22-2004, Textile Test Methods - Colourfastness to Rubbing (Crocking).
- .2 CAN/CGSB-4.2 No.27.6M-2004, Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
- .3 CAN/CGSB-4.2 No. 76-94/ISO 2551: 1981, Textile Test Methods - Machine-Made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions.
- .4 CAN/CGSB-4.2 No.77.1-94/ISO 4919:2000, Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
- .5 CAN/CGSB-4.129-93(R1997), Carpets for Commercial Use.

.4 Canadian Standards Association (CSA)

- .1 CSA B651-12, Accessible Design for the Built Environment.

.5 Carpet and Rug Institute (CRI)

.1 CRI Carpet Installation Standard 2011.

.2 CRI Green Label Indoor Air Quality Testing Program.

.3 CRI Green Label Plus Indoor Air Quality Testing Program.

.6 Environmental Choice Program (ECP)

.1 CCD-152-2009, Flooring Products, Commercial Non-modular Textile Flooring.

.7 Health Canada

.1 C.R.C., c.923-10, Hazardous Products Act - Carpet Regulations, Part II of Schedule 1.

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

.1 Material Safety Data Sheets (MSDS).

.9 National Floor Covering Association (NFCA)

.1 National Floor Covering Specification Manual 2007.

.10 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.11 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-S102.2-10, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning work of this Section with Contractor's Representative and Departmental Representative in accordance with Section 01 31 19 to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other construction subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

.2 Sequencing and Scheduling: sequence with other work in accordance with Section 01 31 13 – Project Coordination. Comply with manufacturer's written recommendations for sequencing construction operations.

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 carpet tile, adhesive, and subfloor patching compound and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit 2 copies of WHMIS MSDS.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Information on shop drawings to indicate:
  - .1 Nap: direction, open edges, special patterns.
  - .2 Cutouts: show locations where cutouts are required.
  - .3 Edgings: show location of edge moldings and edge bindings.

.4 Samples:

- .1 Submit for review and acceptance of each unit.
- .2 Samples will be returned for inclusion into work.
- .3 Submit duplicate samples of each type of carpet tile specified and duplicate tiles for each colour selected, 150 mm length base.

.5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.6 Test and Evaluation Reports:

- .1 Certified test reports showing compliance with specified performance characteristics and physical properties.

.7 Manufacturer's Instructions: submit manufacturer's installation and storage instructions.

.8 Manufacturers Reports:

- .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance with specifications.

.9 Qualification Statements:

- .1 Compliance: to CAN/ULC-S102 and CAN/ULC-S102.2.
- .2 Testing: passes testing requirements of:
  - .1 Green Label Indoor Air Quality Testing Program.
- .3 Tuft bind: meets requirements of CAN/CGSB-4.129 when tested to CAN/CGSB-4.2 No.77.1.

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 installed products for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra stock materials in accordance with Section 01 78 00 – Closeout Submittals: deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00.

- .1 Quantity: provide minimum of:
  - .1 Carpet tile: 2%
  - .2 Carpet base: 5%
  - .3 Adhesives: 2%
- .2 Delivery, storage and protection: comply with Owner's requirements for delivery and storage of extra materials.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements:

- .1 Prequalification: compliance with Health Canada regulations under "Hazardous Products Act", Part II of Schedule 1, to CAN/CGSB-4.2 No. 27.6.

.2 Qualifications:

- .1 Manufacturer: capable of providing field service representation during construction and approving application method.
- .2 Flooring Installer:
  - .1 Experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.
  - .2 Certified by carpet manufacturer prior to bid submission.
  - .3 Must not sub-contract labour without written approval of Departmental Representative.
  - .4 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- .3 Store and protect carpet tile and adhesive in original containers or wrapping with manufacturer's seals and labels intact.

.4 Store and protect carpet tile and accessories in location as directed by Departmental Representative.

.5 Store carpet and adhesive at minimum temperature of 18 degrees C and relative humidity of maximum 65% for minimum of 48 hours before installation.

.6 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.

.7 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.8 Off gas carpet products off site in accordance with CSA B651.

.9 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

.1 Ambient Conditions:

.1 Moisture: ensure substrate is within moisture limits and alkalinity limits recommended by manufacturer. Prepare moisture testing and provide report to Departmental Representative.

.2 Temperature: maintain ambient temperature of not less than 18 degrees C from 48 hours before installation to at least 48 hours after completion of work.

.3 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.

.4 Ventilation:

.1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00. Provide fans with HEPA filters.

.3 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.

.5 Install carpet after space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

1.9 WARRANTY

.1 Manufacturer's warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit other rights Owner may have under Contract Documents.

.2 Warranty period: 1 year, commencing on date of substantial performance of work.

.1 Warranty covers labour and repair or replacement of defective components for 1 year after date of substantial performance.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Manufacturers:

.1 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.

2.2 PERFORMANCE

.1 Flammability: certified for flammability to Health Canada regulations under "Hazardous Products - Carpet Regulations", Part II of Schedule 1.

.2 Flame Spread: maximum flame spread rating 300, maximum smoke developed classification 500, when tested to CAN/ULC-S102.2.

.3 Smoke Development: 450 or less per ASTM E662.

.4 Dry Breaking Strength: to ASTM D2661, minimum acceptable tear strength in both length and width:

.1 11.3 kg for carpets installed by glue down installation.

.5 Wear: maximum 10% of pile face fiber by weight for 10 years.

.6 Edge Ravel: none for 10 years.

.7 Static Resistance: permanent static control to AATCC 134, 2000 V maximum at 20% RH and 22 degrees C.

.8 Static Generation: less than 3.0 kV per AATCC 134 for 10 years.

.9 Tuft Bind: Tuft Lock: to ASTM D1335, minimum acceptable 3.6 kilograms.

.10 De-lamination of Secondary Backing: Lamination Strength of Secondary Backing: to ASTM D3936, minimum acceptable peel strength of 1.6 kg/25 mm.

.11 Stain resistance: to AATCC 175, 8.

.12 Soil Resistance: 350 ppm fluorine minimum. Fluorine Durability Level to AATCC 189.

.13 Colourfastness to light: to CAN/CGSB-4.2 No.18.3

.14 Colourfastness to atmosphere: to AATCC 129 and AATCC 23.

.15 Colourfastness to crocking: to CAN/CGSB-4.2 No. 22.

.16 Indoor Air Quality Certification: certified to CRI Green Label IAQ requirements.

2.3 FABRICATION

.1 Type CPT-1: colour and pattern to be selected by Departmental Representative from manufacturer’s standard range, size 610 mm x 610 mm.

.2 Face construction: Tufted.

.3 Pile Surface Appearance: Level loop; textured.

.4 Pile fibre: to CAN/CGSB-4.129.

.1 Nylon: BCF.

.1 Type: Nylon 6.

.5 Dyeing Method: solution dyed.

.6 Tufted Carpet Backing: to CAN/CGSB-4.129.

.1 Primary backing:

.1 Polypropylene: Cut Pile Carpet: 100% woven polypropylene at a minimum weight of 126 g/m^2.

.7 Secondary and Unitary Backings: to CAN/CGSB-4.129.

.8 Stitches: 39.4 stitches/10 cm.

.9 Gauge: 50.4 rows/10 cm.

.10 Finished Pile Height: minimum 4.7 mm average.

.11 Surface Pile Weight: minimum 711.9 g/sq.m.

.12 Total Weight: 3330 g/sq.m.

.13 Dimensional Stability: maximum + 0.15% to CAN/CGSB-4.2 No. 76/ISO 2551.

2.4 TILE CUSHION BACKING

.1 Density: urethane 224 kg/m^3; EVA and PVC 240 kg/m^3 to ASTM D3574.

.2 Compression force deflection, minimum: urethane 34.5 kN/m^2 to ASTM D3574.

.3 Compression deflection, minimum: EVA and PVC 48.3 kN/m^2 to ASTM D1667.

.4 Compression set at 50%, maximum: urethane 15% to ASTM D3574.

.5 Compression set at 25%, maximum: EVA and PVC 10% to ASTM D3574.

.6 Ash content, maximum: urethane 50%; EVA and PVC 50% to ASTM D297.

.7 Anti-microbial Resistance: to AATCC 174, 2 mm minimum halo of inhibition for gram positive bacteria.

.1 1 mm minimum halo of inhibition for gram negative bacteria.

.2 Ensure no fungal growth.

2.5 ACCESSORIES

.1 Base:

.1 Resilient Base: as specified in 09 65 19.

.2 Edge Strips:

.1 Metal:

.1 Designed for carpet being installed.

.2 Floor flange minimum 38 mm wide, face minimum 16 mm wide.

.3 Finish: clear anodic coating.

.3 Adhesive:

.1 Pressure Sensitive Type: recommended by carpet tile manufacturer for direct glue down installation of specialty backed carpet tiles.

.2 On site application VOC limit: 50 g/L maximum to SCAQMD Rule 1168.

.3 Adhesive in compliance with CCD-152.

.4 Transition Mouldings:

.1 Carpet edge / reducer strip: Extruded vinyl shapes meeting or exceeding ADA Recommendations for change of level transitions for transition between floors finishes having different levels.

.5 Carpet protection: non-staining heavy duty kraft paper.

.6 Subfloor patching compound: Portland cement base filler, mix with latex and water to form cementitious paste.

Part 3 EXECUTION

3.1 INSTALLERS

.1 Use experienced and qualified technicians to carry out assembly and installation of tile carpet.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.

.2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for carpet tile installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.3 PREPARATION

.1 Subfloor Preparation:

.1 Inspect concrete and determine special care required to make it a suitable for carpet.

.2 Fill and level cracks 3 mm wide or protrusions over 0.8 mm with appropriate and compatible latex patching compound.

.3 Comply with manufacturer's written recommendations for maximum patch thickness.

.4 Prime large patch areas with compatible primer.

.5 Ensure concrete substrates are cured, clean and dry.

.6 Ensure concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminates, including sealers, that interfere with the bonding of adhesive.

.7 Where powdery or porous concrete surface is encountered, apply primer compatible with adhesive to provide a suitable surface for glue-down installation.

.2 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

.1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.

.3 Tile Carpeting Preparation:

.1 Pre-condition carpeting: following manufacturer's written instructions.

3.4 INSTALLATION

.1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard and co-ordinate with Section 01 73 00 - Execution.

.2 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.

.3 Install carpet tile after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.

.4 Install carpet tile as per manufacturer's recommendation. This can include quarter-turn 90 degree format, monolithic, random, quarter turn ashlar, horizontal, herringbone or vertical ashlar.

.5 Snugly join carpet tiles in completed installation.

.1 Measure distance covered by 11 carpet tiles (10 joints) and ensure distance is in compliance with manufacturer specifications.

.2 Do not trap yarn between carpet tiles.

.6 Apply thin film of pressure-sensitive adhesive according to manufacturer's recommendations.

.7 Ensure finished installation presents smooth wearing surface free from conspicuous seams, burring and other faults.

.8 Use material from same dye lot.

.1 Ensure colour, pattern and texture match within visual areas.

.2 Maintain constant pile direction.

.9 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.

.10 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

.11 Install carpet tiles smooth and free from bubbles, puckers, and other defects.

.12 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

.13 Base Installation: Install base in accordance with Section 09 65 00 – Resilient Sheet Flooring.

3.5 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

.1 Co-ordinate site test with Section 01 45 00 – Quality Control.

.2 Manufacturer's Field Services:

.1 Co-ordinate manufacturer's services with Section 01 45 00 – Quality Control. Have manufacturer 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:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the 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 3 days of review and submit immediately to Departmental Representative.

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.

.1 Vacuum carpets clean immediately after completion of installation.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Prohibit traffic on carpet for period of 24 hours minimum after installation and until adhesive is cured.

.3 Install carpet protection to satisfaction of Departmental Representative.

.4 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

.1 Architectural Painting Specifications Manual, Master Painters Institute (MPI), 2010.

.2 Systems and Specifications Manual, SSPC Painting Manual, Volume Two, Society for Protective Coatings (SSPC).

.3 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).

.4 National Fire Code of Canada 2010 (NFC).

1.3 QUALITY ASSURANCE

.1 Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.

.5 Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.

.6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

.7 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90° to surface.

.2 Ceilings: No defects visible from floor at 45° to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.4 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

.1 Provide paint products meeting MPI "Environmentally Friendly" E1 ratings based on VOC (EPA Method 24) content levels.

.2 Where indoor air quality (odour) is a problem, use only MPI listed materials having a minimum E2 rating.

1.5 INSPECTION REQUIREMENTS

.1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Departmental Representative and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.

.3 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Departmental Representative.

1.6 SCHEDULING OF WORK

.1 Submit work schedule for various stages of painting to Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Consultant for any changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about the building.

1.7 SUBMITTALS

.1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be used in accordance with Section 01 33 00.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00.

.3 Upon completion, submit records of products used. List products in relation to finish system and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

.5 Manufacturer's Material Safety Data Sheets (MSDS).

1.8 SAMPLES

.1 Submit full range colour sample chips in accordance with Section 01 33 00. Indicate where colour availability is restricted.

.2 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:

.1 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

.2 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.3 When approved, sample panels shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

1.9 QUALITY CONTROL

.1 Provide mock-up in accordance with Section 01 33 00.

.2 When requested by Departmental Representative, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss/sheen, textures and workmanship to MPI Painting Specification Manual standards for review and approval. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar on-site work.

1.10 EXTRA MATERIALS

.1 Submit maintenance materials in accordance with Section 01 33 00.

.2 Submit one - four litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Deliver to Contractor and store where directed.

1.11 DELIVERY, HANDLING AND STORAGE

.1 Deliver, store and handle materials in accordance with Section 01 33 00.

.2 Labels shall clearly indicate:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.

.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Departmental Representative.

.10 Remove paint materials from storage only in quantities required for same day use.

.11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.12 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.12 SITE REQUIREMENTS

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces in accordance with Section 01 35 29.

.2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.

.3 Where required, provide continuous ventilation for seven days after completion of application of paint.

.4 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.

.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.6 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless specifically pre-approved by the specifying body, Paint Inspection Agency and the applied product manufacturer, perform no painting work when:

.1 Ambient air and substrate temperatures are below 10°C.

.2 Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.4 The relative humidity is above 85% or when the dew point is less than 3°C variance between the air/surface temperature.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.2 Perform no painting work when the maximum moisture content of the substrate exceeds:

.1 12% for concrete and masonry (clay and concrete brick/block).

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.

.3 Apply paint only when previous coat of paint is dry or adequately cured.

.4 Additional Interior Application Requirements:

.1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

1.13 WASTE MANAGEMENT AND DISPOSAL

.1 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.,) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.2 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.3 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.4 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.5 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.6 Set aside and protect surplus and uncontaminated finish materials; deliver to or arrange collection by employees, individuals, or organizations for verifiable re-use or re-manufacturing.

.7 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems shall be products of a single manufacturer.

.3 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project.

.4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:

.1 be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.

.2 be manufactured without compounds which contribute to smog in the lower atmosphere.

.3 do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.5 Water-borne surface coatings must be manufactured and transported in a manner that steps of process, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).

.6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.7 Water-borne surface coatings and recycled water-borne surface coatings must have a flash point of 61.0°C or greater.

.8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:

.1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.9 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.

.10 Recycled water-borne surface coatings must contain 50% post-consumer material by volume.

.11 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0 ppm weight/weight total product.

.3 Cadmium in excess of 1.0 ppm weight/weight total product.

.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

.12 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.

.1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.

.2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.

.3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.2 COLOURS

.1 Departmental Representative will provide Colour Schedule after Contract award.

.2 Colour schedule will be based upon the selection of two base colours and two accent colours. No more than five colours will be selected for the entire project.

.3 Selection of colours will be from manufacturers full range of colours.

.4 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

.5 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Departmental Representative's written permission.

.2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.

.3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.

.4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Departmental Representative.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level Category	Units @ 60°	Units @ 85°
G1 – matte finish	0 to 5	max. 10
G2 – velvet finish	0 to 10	10 to 35
G3 – eggshell finish	10 to 25	10 to 35
G4 – satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 – gloss finish	70 to 85	
G7 - high gloss finish	> 85	

.2 Gloss level ratings of painted surfaces as noted on Finish Schedule provided after Contract Award.

2.5 INTERIOR PAINTING SYSTEMS

.1 Concrete Masonry Units: smooth and split face block and brick

.1 INT 4.2D High performance architectural latex finish.

.2 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock type material", etc., and textured finishes

.1 INT 9.2B High performance architectural latex finish.

Part 3 EXECUTION

3.1 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.2 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Departmental Representative. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Stucco, Plaster and Gypsum Board: 12%.

.2 Concrete Block: 12%.

3.3 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect building occupants and general public in and about the building.

.5 Removal of electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings shall be done prior to undertaking any painting operations by General Contractor. Items shall be securely stored and re-installed after painting is completed by General Contractor.

.6 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.7 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Departmental Representative.

3.4 CLEANING AND PREPARATION

.1 Clean and prepare surfaces in accordance with MPI Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

.2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.3 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.4 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air, or vacuum cleaning.

.5 Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated material.

.6 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

3.5 APPLICATION

.1 Method of application to be as approved by Engineer. Apply paint by brush, roller, or air sprayer. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Departmental Representative.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.

.4 Brush out immediately all runs and sags.

.5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Engineer.

.5 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish closets and alcoves as specified for adjoining rooms.

.10 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ ELECTRICAL EQUIPMENT

.1 Unless otherwise specified, paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.

.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.5 Do not paint over nameplates.

.6 Keep sprinkler heads free of paint.

.7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.8 Paint fire protection piping red.

.9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.10 Paint natural gas piping yellow.

.11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.12 Do not paint interior transformers and substation equipment.

3.7 FIELD QUALITY CONTROL

.1 Field inspection of painting operations to be carried out by independent inspection firm as designated by Departmental Representative.

.2 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.3 Co-operate with inspection firm and provide access to areas of work.

3.8 RESTORATION

.1 Clean and re-install all hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 12 35 53 - Steel Laboratory Casework

1.2 REFERENCES

.1 Aluminum Association (AA)

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

.2 ASTM International

.1 ASTM A490M-12, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.

.2 ASTM A653/A 653M-13, Standard Specification for Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.81-M90(R1990), Air Drying and Baking Alkyd Primer for Vehicles and Equipment.

.2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.

.3 CGSB 31-GP-107Ma-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.

.4 CSA Group

.1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.5 Green Seal (GS)

.1 GS-11-2013, Standard for Paints and Coatings.

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

.1 Material Safety Data Sheets (MSDS).

.7 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #76, Quick Dry Alkyd Metal Primer.

.2 MPI #96, Quick Dry Enamel Gloss.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal shelving 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 Ontario, Canada.

.2 Indicate shelving layouts, number of bays, number of shelves, number and size of drawers, bins, number of dividers, system of bracing and anchoring devices.

.4 Samples:

.1 Submit representative sample bay of specified shelving showing finish colour and including accessories.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Design and construct metal storage shelving to support uniform load of 1220 kg per m^2 of span and to support maximum load of 6100 kg per bay.

.2 Design shelving to accommodate vertical adjustment of shelves in 50 mm increments and to permit easy assembly, expansion, dismantling and re-use of shelving component parts.

2.2 MATERIALS

.1 Galvanized steel sheet: commercial grade to ASTM A 653/A 653M with Z275 zinc coating.

.2 Steel sections and plates: to CSA G40.20/G40.21, Type 400 W.

.3 Steel bolts, nuts and washers: to ASTM A490M.

.4 Welding materials: to CSA W59.

.5 Shelving:

.1 Storage shelving:

.1 Size: to dimensions shown in Drawings.

2.3 COMPONENTS

.1 Uprights:

.1 Roll formed steel angles or tees with perforations to accommodate shelves and other components.

.2 Size and thickness of angles or tees to support specified total load.

.2 Shelves:

.1 Brake formed sheet metal, reinforced to carry specified loads.

.2 Punch holes in shelves to accommodate dividers and other components.

.3 Kickplates: formed sheet metal to close opening between bottom shelf and floor on front and on sides of shelving bay.

.4 Back: 0.6 mm core thickness steel sheet to enclose shelving bay extending from bottom shelf to top shelf.

.5 Side panels: 0.6 mm core thickness steel sheet panels to close ends of shelving bays or sections and as partitions between adjacent bays.

.6 Dividers:

.1 Reinforced sheet metal plates for subdividing shelves into bins.

.2 Provide for attachment of dividers to shelves immediately above and below dividers.

.7 Bin fronts: formed sheet metal, attached to front edge of shelf to prevent small parts from falling over edge of shelf.

.8 Gusset plates: heavy gauge metal plates to reinforce corner connections of shelving components.

.9 Braces:

.1 Provide sway braces for open type shelving.

.2 Use side sway braces on two exposed sides of each rack and at alternate bays.

.3 Use back sway braces on two end sections of each bank and on alternate bays.

.10 Label holders: attachable to front edge of shelf with provision to hold paper or plastic label.

.11 Drawers: of sizes indicated, complete with pull hardware, dividers and label holders.

.12 Base plates: metal or plastic plates to take uprights and to protect floor surfaces.

2.4 FINISH

.1 Finish shelving system vinyl coated in standard colour selected by Departmental Representative.

.2 Condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma.

.3 Apply one coat type 2 primer to CAN/CGSB-1.81 and bake.

.4 Apply two coats of type 2 enamel to CAN/CGSB-1.88 and bake to hard durable finish.

.5 Manufacturers or brand names on face of units 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 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal shelving 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.

3.3 INSTALLATION

.1 Do metal storage shelving work except where specified otherwise.

.2 Install metal storage shelving in accordance with reviewed layout.

.3 Brace, secure and anchor shelving units in place.

.4 Make good baked enamel surfaces damaged during shipment or installation.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for cabinet mounted laboratory fume hoods in the following configurations:

.1 Variable air volume fume hoods.

.2 Laboratory fittings and fixtures specified in Section 11 53 43, and required by this Section shall be supplied and installed integrally fume hoods; connection to services will be completed by Division 22 and Division 23 and Division 26.

1.2 RELATED DOCUMENTS

.1 PWGSC MD 15128 Laboratory Fume Hoods – Guidelines

1.3 RELATED REQUIREMENTS

.1 Section 11 53 43 – Laboratory Service Fittings and Accessories: Gas, water and electrical fittings common to laboratory casework and fume hoods.

.2 Section 12 35 53 – Steel Laboratory Casework

.3 Division 22 – Plumbing: Plumbing rough-in and connection.

.4 Division 23 – Heating, Ventilating and Air Conditioning: Duct work rough-in and connection. Pressure alarm and differential pressure gauge.

.5 Division 26 – Electrical: Wire ways and devices, rough-in and connection.

1.4 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

.1 ANSI/AIHA Z9.2-2001, American National Standard for Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

.2 ANSI/AIHA Z9.5-1992, Standard for Laboratory Ventilation

.2 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):

.1 Standard 110-1995, Method of Testing Performance of Laboratory Fume Hoods (ANSI approved)

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

.2 ASTM A240/A240M-13b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

.3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.4 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.5 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

.6 ASTM B456-03, Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

.7 ASTM D522-93a(2001), Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings

.8 ASTM E84-04, Standard Test Method for Surface Burning Characteristics of Building Materials

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 12.1-M90, Glass, Safety, Tempered or Laminated

.5 Canadian Standards Association (CSA):

.1 CSA C22.2 NO. 151-M1986(R2004), Laboratory Equipment

.2 CSA C22.2 NO. 1010.1-92(R1999), Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General Requirements

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

.4 CAN3 O188.1-M78, Interior Mat-Formed Wood Particleboard

.5 CSA Z316.5-04, Fume Hoods and Associated Exhaust Systems

.6 National Fire Protection Association (NFPA):

.1 NFPA 30-2000, Flammable and Combustible Liquids Code

.2 NFPA 45-2000, Standard on Fire Protection for Laboratories Using Chemicals

.7 Scientific Equipment and Furniture Association (SEFA):

.1 SEFA 1.2-2002, Laboratory Fume Hoods

.2 SEFA 3-1996, Work Surfaces

1.5 COORDINATION

.1 Coordinate with Division 22, Division 23 and Division 26 for proper and correct installation of plumbing, ducting and electrical rough-in and other affected Sections for rough opening dimensions required for installation of specified fume hood and equipment.

1.6 SYSTEM REQUIREMENTS

.1 Provide fully tested and functional fume hoods as described in this section with specific operational characteristics as listed below.

.2 Automatic Air Bypass:

.1 Automatic air bypass system shall incorporate an automatic compensating opening or make-up air unit, as applicable, that functions as the sash is lowered or raised.

.2 Air drawn through the bypass shall pass through the hood interior to dilute generated fumes.

.3 The bypass shall limit the face velocity and maintain a relatively constant exhaust volume.

.3 Face Velocity: Face velocity shall be designed to meet Class A fume hood requirements with an average of 38 to 45 m/min with a sash opening of 305 mm, with a corresponding minimum reading of 30 to 38 m/min with the sash in the full open position.

.4 Static Pressure Loss: Static pressure loss and exhaust volume shall be relatively constant regardless of sash position.

.5 Safety:

.1 Install label indicating sash opening height.

.2 Install label indicating proper pressure gauge reading required for safe operation.

.3 Install pressure alarm and differential pressure gauge, providing an alarm to operators for unsafe operating conditions with a manual shut-off for maintenance or false alarm conditions.

.6 Pressure Alarm and Differential Pressure Gauge: Division 23

.1 Pressure alarm and differential pressure gauge, providing an alarm to operators for unsafe operating conditions with a manual shut-off for maintenance or false alarm conditions.

1.7 QUALITY ASSURANCE

.1 Where governed by code requirements in their final installed locations, items of this Section shall conform to the Building Code and all other standards as noted.

.2 Electrical and operating items shall be CSA or ULC approved and carry the appropriate CSA or ULC label in accordance with Section 01 61 00 – Common Product Requirements: Fire Rated Separations, Assemblies and Materials.

.3 Fume hoods shall be manufactured by a fabricator having a minimum of 10 years experience in the design, fabrication and installation of highest quality research scientific laboratory fume hoods, manufactured to highest laboratory standards and accuracy:

.1 Provide evidence of experience and list of similar projects with Bid Submission.

1.8 MANUFACTURER QUALIFICATIONS

.1 Manufacturer shall have an established organization; experienced engineering department and production facilities specializing in fume hood fabrication.

.2 Manufacturer shall have demonstrated ability to produce equipment of the required quality, and the proven capacity to complete an installation of this size and type within the required time limits.

.3 Fume hood evaluation of the manufacturer's product shall take place in the manufacturer's test facility with samples, apparatus, instruments, and test materials to be supplied by the manufacturer at no cost to the Departmental Representative. At his option, the Departmental Representative may verify data with his own instruments, providing instrument suitability and calibration are mutually acceptable.

.4 Perform factory testing in accordance with the requirements of CSA Z316.5, CSA C22.2, No. 151, ASHRAE 110 and SEFA 1.2 Standards listed in 1.4 above.

.5 CSA Approval:

.1 Fume hoods and components used to construct fume hoods shall be certified and approved by CSA.

.2 Provide CSA identification in a visible identification on the front of hood exterior.

1.9 SUBMITTALS

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

.2 Submit information on the type of fume hood and exhaust system; and any specific limitations on use.

.3 Submit detailed shop drawings of each piece of equipment listed in this Section showing size, installation, preparation, services required and rough-in requirements, operation, construction materials, finishes, joints installed on site, wiring and piping diagrams, controls, and similar items.

.4 Submit test results of manufacturers testing indicating performance levels prior to delivery of specified items; manufacturer’s testing will form the baseline result for assessing performance of site testing requirements.

.5 Manufacturer's publications are acceptable for standard non-custom specialties if the specific model or type fully shown along with all available accessories, features.

.6 Submit two (2) samples, minimum size 50 mm x 100 mm, of material or finish when requested by Consultant.

1.10 MAINTENANCE DATA

.1 Provide required data in accordance with Section 01 78 00 – Closeout Submittals: Equipment and Systems.

.2 Submit two (2) copies of complete operating and maintenance data for each specified item in this Section including the following:

.1 Operating and maintenance instructions.

.2 As-built drawings showing the complete installation.

.3 Name, address and telephone number of nearest representative for parts supply and servicing.

.4 Identification of construction materials.

.5 Make, model, and serial number of installed units.

.6 Results of site testing and commissioning.

1.11 DELIVERY, STORAGE AND HANDLING

.1 Do not deliver items or materials to the site until that area or part of the project in which the item is to be installed is ready to receive the Work.

.2 Finished items, components, assemblies shall be wrapped and crated in a manner to protect materials and finishes from damage during shipping and handling.

.3 Store items carefully protected from moisture and damage, in original wrappings with manufacturer's labels, seals intact.

.4 Tie or secure all moving parts so that no damage will occur during shipping, handling.

1.12 SITE CONDITIONS

.1 Protect surfaces, materials, and finishes of other Work from damage during Work of this Section.

.2 Where connections to mechanical, electrical or other trades required, provide all data, dimensions, drawings in time for proper roughing-in and preparation required to receive the Work.

Part 2 Products

2.1 MATERIALS

.1 Materials used to construct fume hoods shall meet or exceed the requirements of CSA Z316.5, suitable for the specific end use that each item or assembly is intended for the Project, and as follows:

.1 Sheet steel: Stretcher levelled furniture grade to ASTM A1008/A1008M, galvanized, thickness as indicated.

.2 Stainless steel: To ASTM A167 and ASTM A240/A240M, Type 316 with #4 finish.

.2 Fume Hood Type:

.1 Variable Air Volume Type.

.3 Hood Size:

.1 FH-1:

.1 Nominal Interior: 760 mm.

.2 Width: 1525 mm.

.3 Height: 1500 mm.

.4 Depth: 990 mm.

.4 Hood Configuration and Classification:

.1 Single Sided, Barrier Free Access.

.2 Cabinet Mounted Type.

.3 Standard Laboratory Acid and Solvent Usage Classification.

.4 Vapour Proof.

.5 Liner and Baffle Material:

.1 Polyvinyl Chloride: Polyvinyl chloride (PVC), 5 mm thickness, corners square.

.2 Removable interior side panels for access to service fittings.

.6 Work Surface:

.1 Moulded Epoxy: Epoxy resin (EP), dished profile, with cut-outs for sink, service access and ventilation requirements.

.7 Equipment Struts: Stainless steel channel to each side of inner liner at attachment locations; stiffen liner panel as required from behind to permit positive attachment.

.8 Exterior Panels: Front and side panels, furring panels to conceal duct work finished same as front panel, dress rear panel finished same as front panel, and as follows:

.1 Prefinished Panels: Epoxy coated, cold rolled steel (PF), minimum 1.214 mm thickness.

.2 Access Opening: Provide access opening at the rear of fume hood, concealed between the walls on both sides, to facilitate connection of fume hood service fittings to piping located in service chase behind laboratory casework.

.9 Sash:

.1 Type: Vertical Rising.

.2 Glass: 6 mm thick tempered safety glass in accordance with CGSB 12.1.

.3 Frame: Minimum 1.519 mm Type 316 stainless steel frame assembly; adjustable to stop at any position and be easily movable, and as follows:

.1 Provide positive seal to sash for correct air bypass operation.

.2 Sash guides, internal sash surfaces and counterbalance mechanism shall be fabricated from fire rated and corrosion resistant materials; sash cords shall be stainless steel.

.4 Stop: Manufacturer's standard sash limit stop.

.5 Sash Air Foil: Minimum 1.519 mm Type 316 stainless steel having directional #4 satin finish, and as follows:

.1 Mounted on bottom front of hood, to direct air across working surface and seep air back to lower baffle exhaust slot.

.2 Provide minimum 70 mm space back-set between airfoil and front edge of the working top to provide a continuous flow of air.

.6 Automated self-closing sash:

.1 An automated sash w/ multiple opening detents and self closing technology with occupancy detection system which automatically lowers the sash.

.2 Coordinate fume hood monitor and sash position monitor provided by Division 23.

.1 Factory install fume hood monitor and sash position monitors provided as part of the fume hood exhaust air control valve, refer to section 23 36 00 Air Terminal Unit for details.

.10 Air Handling Requirements:

.1 Sound Level: 67 dBA or less when measured in accordance to NSF 49.

.2 Exhaust Connection: Type 316 stainless steel, quantity as required for efficient operation and proper air flow.

.3 Pressure Gauge: Manufacturer's standard magnahelic pressure gauge to monitor air flow; mounted in visible location on rear wall of interior, connected to a positive pressure duct.

.4 Internal Ductwork: Stainless Steel.

.5 External Air Balancing System: Controlled orifice type.

.6 Fume Vents for Acid Base Storage Cabinets and Flammable Storage Base Cabinets, coordinate with Section 12 35 53, and as follows:

.1 Corrosion resistant fume vent pipe installed behind baffles at 150 mm O/C.

.2 Minimum 38 mm Ø vent extending minimum 100 mm above the interior surface with removable cap in end protruding from the fume hood interior.

.11 Service Fittings: All components pre-plumbed up ready for connection by Division 22, and as follows:

.1 Sink: 76 mm x 150 mm oval cup sink, to match countertop material, sealed into work surface; with tail piece, located at back corner to align over casework services space.

.2 Service Fixtures: Quarter-turn, on/off Type, remote operation as scheduled in Section 11 53 43, and as follows:

.1 Natural Gas Fitting: One (1), NG.

.12 Electrical Components: All components pre-wired ready for connection by Division 26, and as follows:

.1 Wiring:

.1 Standard Units: Switch for light and switch for motor start; internal wiring to circuit junction boxes.

.2 Lighting:

.1 Standard Lighting: Manufacturer's standard system, serviceable from outside fume hood cavity with tempered glass safety shield on top of the hood liner, and providing 5200 Lumens across working surfaces using one of the following lamp solutions or a combination of both lamp solutions:

.1 4100K low mercury, long life 25 to 28 Watt T8 or T5 fluorescent lamps.

.2 4100K LED lamp with a minimum 50,000 hour system life based on LM-79 and LM-80 Standards.

.3 Receptacles: Two (2), 120 Volt x 15 Amp, GFI receptacles as listed in Section 11 53 43.

.13 Accessories:

.1 Face velocity alarm to continuously monitor hood performance, having site calibration feature, digital readout audible and visual alarm activating when airflow falls below a pre-set velocity; allow for future connection to centralized building monitoring system for remote alarm activation.

.2 Data Card Holder: 0.912 mm thickness stainless steel frame secured to exterior of fume hood, including acrylic glazing and removable data card describing characteristics, operation and site test data, for each fume hood.

.3 Paper tissue screen located behind baffle to prevent paper towels and other debris from blocking exhaust system.

2.2 FABRICATION

.1 Shop fabricate, assemble and finish fume hoods with fastenings concealed or countersunk flush; joints in exposed surfaces to hairline profile with complete internal piping, wiring, ducting, shop installed and tested, having mechanical and electrical fittings and fixtures installed in accordance with CSA Z316.5.

.2 Assemble equipment accurately, free from distortion or defects detrimental to appearance and operation.

.3 Provide equipment ready for site hook up to building services; connections to suit adjacent casework service strip.

Part 3 Execution

3.1 INSPECTION/PREPARATION

.1 Inspect the work of other Sections upon which the work of this Section depends; proceed only after deficiencies, if any, in the Work of other Sections have been corrected.

.2 Verify dimensions affecting the Work of this Section on the site.

.3 Coordinate anchors, frames or other items required by this Section and installed by other Sections, or supplied to other Sections by this Section for building into their Work are properly located and securely mounted.

.4 Verify that services required by this Section are roughed-in and of the required capacity.

3.2 EXAMINATION

.1 Verify equipment rough-in before proceeding with work.

3.3 INSTALLATION

.1 Install according to manufacturer's instructions.

.2 Install according to standards required by authority having jurisdiction.

.3 Install equipment plumb, square and straight with no distortion and securely anchor as required.

.4 Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner:

.1 Connect power operated equipment to power source in accordance with requirements of Division 26; motors, controls and switches shall be supplied under this Section as part of specified equipment.

.2 Connect mechanical services to building sources in accordance with requirements of Division 22; sinks, faucets, gas fittings, drains and other items shall be supplied under this Section as part of specified equipment.

.3 Connect ductwork to building sources in accordance with requirements of Division 23.

.4 Division 23 and 25: Connect controls to fume hood monitor and sash position sensor monitor in accordance with requirements of Division 23 and 25.

.5 Touch up minor damaged surfaces caused by installation; replace damaged components as directed by Consultant.

3.4 SITE QUALITY CONTROL

.1 Conduct site tests in accordance with CSA Z316.5, ASHRAE 110, SEFA 1.2 and CSA C22.2 to verify equipment performance, using factory testing results as baseline for performance.

.2 Correct equipment not passing test results as directed by authorities having jurisdiction and the Consultant.

.3 Tests shall include, but not be limited to, the following:

.1 Confirmation of As Manufactured Condition.

.2 Face Velocity.

.3 Flow Containment.

.4 Sash Operation.

.5 Baffle Operation.

.6 Alarm Function.

.7 Exhaust Operation.

.4 Commission installation in accordance with Section 01 91 13 – General Commissioning Requirements and as follows:

.1 Verify and witness electrical safety.

.2 Measure, verify and witness lighting levels within fume hoods.

.3 Measure, verify and witness noise levels with the room.

.4 Verify and witness functioning of components and services.

.5 Verify and witness site test results listed in Item 3.4.3 above.

3.5 ADJUSTING

.1 Adjust operating equipment, with exception of air moving equipment installed by Division 23, to efficient operation for its intended use, and verify that equipment will function correctly within manufacturer's tested performance criteria; make any adjustment or realignment necessary for smooth, trouble-free operation.

.2 If smooth and correct operation cannot be fully verified by site work and adjustment, ship the affected assembly to the factory for reworking and reinstalled in place at no additional cost or delay to the Departmental Representative.

3.6 CLEANING

.1 Clean equipment, casework, countertops and all other surfaces as recommended by the manufacturer, rendering all work in a new and unused appearance.

.2 Clean adjacent construction and surfaces, which may have been soiled in the course of installation of work in this section.

3.7 PROTECTION OF FINISHED WORK

.1 Provide protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.

.2 Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.

3.8 DEMONSTRATION

.1 Provide systems demonstration and demonstrate all equipment operations and functions in accordance with CSA Z316.5.

3.9 SCHEDULE

.1 Bench Top Fume Hood Type – Chemical (FH-1):

- .1 Size: 1220 mm wide x 990 mm deep.
- .2 Ventilation Type: Variable Air Volume.
- .3 Sash Configuration:
  - .1 Operation: By-pass constant low flow; raising vertical sash, single hung frame. Number of sash varies with width, see Drawings.
  - .2 Full Opening Height: 670 mm to 725 mm.
  - .3 View height: 780 mm to 900 mm.
- .4 Work Top: Epoxy.
- .5 Service Fittings and Sinks: See Drawings.
- .6 Additional Requirements: Comply with PWGSC MD 15128 Laboratory Fume Hoods – Guidelines.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Provide lab fittings and fixtures specifically designed for laboratory use, as scheduled, shown on the Drawings, and as specified herein:

.1 Laboratory service fittings and related components include items listed or scheduled in other sections of the work relating to fume hoods and laboratory casework.

.2 Laboratory sinks and fixtures for installation in work surfaces and singularly mounted as a component of fume hoods and laboratory casework, or forming a part of the work within a laboratory area.

.3 Laboratory lighting, electrical boxes and pedestals built into fume hoods and laboratory casework, not including connection to services.

.2 Laboratory fittings and fixtures specified in this section shall be supplied and installed integrally with fume hoods and laboratory casework as a part of the scope of work for Division 11 and Division 12.

.3 Connection to services shall be coordinated with and completed by Division 23 - Mechanical and Division 26 - Electrical.

1.2 RELATED REQUIREMENTS

.1 Section 22 42 01 - Plumbing Specialties And Accessories: Free standing emergency eyewash and shower equipment.

.2 Section 11 53 13 - Fume Hoods

.3 Section 11 53 43 – Service Fittings and Accessories

.4 Section 12 35 53 - Laboratory Casework

.5 Section 23 05 00 - Common Work Results - Mechanical: Plumbing rough-in and connections by Division 23 to fume hood and counter mounted water or gas supply lines, to waste lines, and central building exhaust systems.

.6 Division 26 - Electrical General Requirements: Electrical rough-in and connections by Division 26 to fume hood and counter mounted electrical components.

.7 Section 26 05 32 - Outlet Boxes, Conduit Boxes And Fittings And Section 26 05 34 - Conduits, Conduit Fastenings And Conduit Fittings: Materials supplied and installed by Division 26.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers International (ASME):

.1 ANSI/ASME A112.18.1-11, Plumbing Fixture Fittings

.2 ANSI Z358.1-2009, Emergency Eyewash and Shower Equipment

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A167-99, Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

.2 ASTM A240/A240M-13b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

.3 ASTM A312/A312M-13b, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

.4 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.3 Canadian Standards Association (CSA):

.1 CAN/CSA B125-01, Plumbing Fixtures

.2 CAN/CSA B64 Series-01, Backflow Preventers and Vacuum Breakers

.4 Scientific Equipment and Furniture Association (SEFA):

.1 SEFA 2.3-2010, Installation of Scientific Laboratory Furniture and Equipment

.2 SEFA 3-2010, Work Surfaces

.3 SEFA 7-2010, Laboratory and Hospital Fixtures, Recommended Practices

1.4 QUALITY ASSURANCE

.1 Items of this Section shall conform to the Building Code and all other standards as noted where governed by code requirements in their final installed locations.

.2 Electrical and operating items shall be CSA or ULC approved and carry the appropriate CSA or ULC label in accordance with Section 01 61 00 – Common Product Requirements.

.3 Laboratory fittings and fixtures shall be manufactured or furnished by the same supplier for fume hoods and laboratory casework for single responsibility and coordination.

.4 Fabricator shall be experienced in fabrication, be currently engaged in regular production, and have adequate facilities and personnel to construct the specified systems.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 33 00.

.2 Submit complete materials list, including catalogue data of products.

.3 Submit results of Protective Coating Testing required by SEFA 7, Section 5.3, and final installation testing as required by this Section.

.4 Provide operations and maintenance information in accordance with Section 01 78 00 – Close Out Submittals: Operation and Maintenance Data; describe proper operating procedures, maintenance and replacement schedules, components parts list, and nearest local representative for components and emergency repairs, including address and Telephone number.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Fittings and fixtures shall be in recommended packaging, with each fitting individually packaged, marked, and scheduled for point of use.

.2 Inventory and store in a clean, dry location at job site, verify that type and quantity are correct, and re-package, if necessary, until installation.

.3 In the event of damage, immediately make repairs and replacements to the satisfaction of and at no additional cost to the Owner.

1.7 COORDINATION

.1 Coordinate with Division 22 and Division 23 for mechanical connections.

.2 Coordinate with Division 26 for electrical connections, and device and plate identification system.

Part 2 Products

2.1 MATERIALS

.1 Provide factory assembled fittings including, but not limited to, the following:

.1 Nipples, lock nuts, shanks, and other items required for a positive attachment to supporting structure.

.2 Wall and deck flanges, escutcheons, handle extension rods, and other items required for proper operation of fittings.

.3 Replaceable seats, needle cones, valve disc screws and other accessories shall be of the same type as originally specified and specific for use intended.

.4 Flanges, turrets and other male and female threaded components shall be formed or forged to meet standard 10 mm IPS coupling requirements.

.5 Removable serrated tip hose fittings shall have thread inlet with hose end tapered having not less than ten serrations; 3 mm Ø orifice at tip of hose end.

.6 Renewable or easily replaceable components for working parts that are subject to wear arising from use.

.2 SEFA 7 Guidelines and material requirements listed above apply to faucet, turret and valve fittings specified in this Section.

2.2 FAUCET FITTINGS AND TURRETS

.1 Turret fittings for valve assemblies and goosenecks shall include, but not be limited to, the following:

.1 Prepare laboratory turrets for 1, 2, 3 and 4 outlet configurations as listed in the Valve Schedule.

.2 Solid brass construction with a high gloss polished chrome finish, or solid stainless steel with #8 mirror finish.

.2 Handles for fittings shall include, but not be limited to, the following:

.1 Plastic handles for fittings installed inside of fume hoods; chrome plated brass or stainless steel forged handles in all other locations, unless noted otherwise.

.2 Equip ground key cock valves with a single long handle; blade parallel with nipple for “on” position; blade perpendicular to nipple for “off” position.

.3 Equip high pressure valves, needle valves and steam valves with round knurled handle; other handle types as noted in Valve Schedule.

.4 Coloured index button with embossed identification letters at each handle, and as follows:

.1 Secure button to handle with tamperproof attachment.

.2 Colour and code button in accordance with SEFA 7 standards, and as indicated in schedules.

.3 Button colour and code for other services will be as determined by Owner's Representative.

.3 Gooseneck faucet fitting shall include, but not be limited to, the following:

.1 Chrome plated, heavy wall brass or stainless steel tube construction with cast or forged brass or stainless steel valve body.

.2 Valve body accepting easily replaceable valve mechanism and valve seat.

.3 150 mm spread x 140 mm from top of deck to tip of removable serrated hose end.

.4 Set valve body for Left or Right Hand, or 180° operation as appropriate to installation location.

.5 Vacuum Breakers:

.1 Integral with the gooseneck; forged brass or stainless steel body.

.2 Renewable seat and valve member for fine flow control.

.3 Vacuum breakers shall not spill over at a low water volume.

.6 Provide anti-splash outlet and full thread for attachment of serrated tips or filter pumps.

.7 Hot/cold water gooseneck mixers and cold water goosenecks shall be convertible for fixed/swivel operation:

.1 Swivel point shall be at turret or at valve level.

.2 Swing joints shall have Teflon packing with adjustable packing nut or double “O” ring seals.

.4 Spout faucet fitting shall include, but not be limited to the following:

.1 Chrome plated, heavy wall brass or stainless steel tube construction with cast or forged brass or stainless steel valve body.

.2 Valve body accepting easily replaceable valve mechanism and stainless steel valve seat.

.3 150 mm reach; working pressure rated capacity at 8 L/min @ 400 kPa.

.4 Swivel point shall be at mixer level; swing joints shall have Teflon packing with adjustable packing nut or double “O” ring seals.

.5 Equip spout with aerator.

2.3 VALVE FITTINGS

.1 Water Valves:

.1 Chrome plated, cast or formed brass or stainless steel valve body with integral or external adjustable flow volume control.

.2 Convertible compression cartridge allowing quick change to self-closing closing cartridge without disturbing faucet body.

.3 Metal-to-metal or ground-joint type of sealing is not acceptable.

.2 Ground Key Cock Valves (On/Off Control of Gas or Air):

.1 Cocks shall be individually ground and lapped, with spring loaded design to compensate for normal wear.

.2 Working pressure rated to 275 kPa; argon tested pressure rated to minimum 550 kPa.

.3 Standard Needle Valves (Air, Vacuum, Specialty Gases):

.1 Needle valve fittings shall have a precision ground, self-centring, and replaceable floating cone seated against a renewable valve seat.

.2 Slow compression working pressure rated to 1035 kPa; nitrogen tested pressure rated to minimum 1550 kPa.

2.4 QUICK DISCONNECT FITTINGS

.1 Equip valves providing services at a pressure exceeding 240 kPa, and other valves noted in Valve Schedule, with double end shut off (DESO) quick disconnect coupling.

.2 Do not provide quick disconnect fitting to valves noted for threaded direct piping connection.

.3 Tip orifices of 3 mm will not be acceptable.

.4 Colour key coupling to prevent accidental intermixing of different lines; coordinate colour keying with Departmental Representative.

.5 Coordinate stem and body types with Departmental Representative's requirements.

2.5 FITTING FINISHES

.1 Specialty Finish: Provide grey epoxy corrosion resistant finish for service fittings installed inside fume hoods. Corrosion resistant finish to conform to following minimum requirements.

.1 Acid resistance: acid applied at rate of 60 drops per minute for 10 minutes on fixture coatings held approximately at angle of 45 degrees:

.1 Hydrochloric acid: 36.9%.

.2 Nitric acid: 70.6%.

.3 Sulfuric acid: 96.4%.

.4 Acetic acid: 96.4%.

.5 Discolouration and slight bubbling may occur with concentrated sulphuric acid only.

.2 Resistance to alkali and organic solvents: reagents and solvents applied at rate of 60 drops per minute on fixture coatings held approximately at angle of 45 degrees: alkali (50% sodium hydroxide), ethyl alcohol, toluol, xylol, benzol, carbon tetrachloride, phenol and mineral oil.

.3 Resistance to salt fog spray: samples of fixtures placed in salt fog cabinet for period of 125 hrs at temperature of 34-36 degrees C. Artificial sea water (composite per litre: 11 g MgC6HO, 1.2 g NaSO, and 25 g NaC1). Fixtures tested to ASTM B117 for 1000 hours.

.4 Resistance to high humidity: samples of fixtures placed in high humidity cabinet maintained at 100% RH and 50 degrees C for period of 125 hours.

.5 Resistance to acid fumes: samples of fixtures placed in closed cylindrical glass containers approximately 20 L in volume, together with beaker of concentrated hydrochloric acid, nitric acid, and sulphuric acid. Maintain 23 degrees C temperature for period of 150 hours.

.6 Submit an independent testing laboratory report certifying that the chemical resistant coating is capable of withstanding the SEFA 7, Section 5.3 corrosion resistant finish test.

2.6 LABORATORY SINKS

.1 Compatibility with work surface material:

.1 Provide epoxy resin work sinks for epoxy resin work surfaces unless noted otherwise;

.2 Provide standing overflow, when in position, 25 mm below flood level of sink. Include perforated over-flow guard with top 12 mm below flood level.

.3 Locate waste outlets where indicated.

.4 Provide sink supports, outlets, strainers, and tailpieces required for complete installation of similar materials to sinks; sealants non-hardening, chemically resistant silicone for joints between work surface and sink, and as follows:

.1 Provide supports for sinks in cabinets; minimum of two (2) 3.18 mm steel channels 25 mm x 50 mm x 25 mm, extending across width of cabinet and attached by 10 mm Ø threaded hanger rods, with chemical resistant finish.

.2 Provide supports for sinks in table frame; minimum two (2) “U” shaped steel 50 mm wide x 6 mm thick, screwed to cross rails, provide 50 mm x 13 mm steel for sinks having bottom area greater than 1600 mm², with baked enamel finish.

.5 Epoxy Resin Sinks:

.1 Drop-in type epoxy resin sinks integrally moulded from modified thermosetting epoxy resin in colour selected by Departmental Representative, oven cured with threaded outlet; top of sink flush with top of work surface.

.2 Inside corners coved, with bottom pitched to drain outlet.

.6 Accessories:

.1 Standing Overflow: Type 316 stainless steel sink plug on chain and crossbar, 50 mm Ø with strainer and removable standing overflow, height 25 mm less than depth of sink bowl.

.2 Basket Crumb Cup Strainer: 98 mm to 100 mm Ø Type 316 stainless steel strainer with removable basket and stainless steel tailpiece.

2.7 ELECTRICAL SERVICE FIXTURES

.1 Electrical and communications fixtures shall be labelled in accordance with the requirements of CSA and other applicable standards and regulations as listed in Section 26 05 00.

.2 Electrical boxes shall be machined to fit both standard and ground fault receptacles, with grounding screws, mounting shank and locknut; and shall be fire rated where applicable.

.3 Pedestals shall have integral bases, with nipples, nuts, shanks, and other items required for a positive attachment to supporting structure and conduit.

.4 Provide units with outlet box, terminals, and gaskets required for a complete operating system, and as follows:

.1 Flush boxes shall be galvanized steel.

.2 Flush plates shall be Type 316 stainless steel having #4 satin finish with formed bevelled edges.

.3 Conduit in reagent racks shall be rigid type, sized to accommodate number of wires being pulled.

.1 Casework raceways shall be multi-channel to accommodate normal power, emergency power, and data to meet all codes including Canadian Electrical Code.

.4 Boxes, component parts and fittings shall be of the screw type.

.5 Exposed conduit and fittings shall have a chemical resistant enamelled finish.

.6 Pedestal and line type housing, flush boxes, receptacles, and flush plates shall be grounded.

.5 Mark cover plates at receptacles, switches, terminal posts and other locations as specified in Division 26 - Electrical.

2.8 INTEGRATED TASK LIGHTING

.1 Provide complete flush mounted LED task lighting recessed into upper casework, prewired with whip connection and as follows:

.1 Luminous flux: minimum 1200 lumens

.2 Colour Temperature: 4000K

.3 Beam Angle: 120^{o}

.4 Switch: Touchless sensor

.2 Integrated lighting shall be wired on a separate circuit from receptacles.

Part 3 Execution

3.1 EXAMINATION

.1 Prior to ordering and delivery of fittings and fixtures carefully review the work and verify that this installation may properly commence, can be complete, and is appropriate for its intended use.

.2 Verify that work may be installed in complete accordance with the original design, reviewed submittals, and the manufacturer's written recommendations.

3.2 INSTALLATION

.1 Fittings and fixtures shall be installed in strict accordance with the manufacturer's written recommendations, the original design, and accepted submittals.

.2 Fittings located on the same plane shall have their handles project similar distances for a uniform, related appearance, regardless of valve type.

.3 Remove piping, assembly, and manufacturing debris.

3.3 TESTING

.1 Faucets, valves, and fittings shall meet or exceed the SEFA working pressures and discharge the minimum or greater in accordance with minute SEFA flow.

.2 Finishes and coatings shall withstand the SEFA 7, Section 5.3 chemical resistance tests.

.3 Test under mounted sinks by filling level with work surface with water; confirm sink exhibits no leakage or sagging.

3.4 ADJUSTING AND CLEANING

.1 Adjust fittings and fixtures so that they are working in accordance with design intent, with referenced standards, and have been cleaned and polished.

3.5 SCHEDULES

.1 Air/Gas/Vacuum Fittings - Combination Valve and Flange:

Mark	**Valve Type**	**Hose Nozzle**	**Handle**	**Index Button**	**Configuration**
NG	Fine Control Needle Valve	Serrated	Lever	Symbol: NAT GAS Letter: White Index: Blue	Single Fitting, remote operating type
CA	Fine Control Needle Valve	Serrated	Lever	Symbol: CA Letter: Black Index: Orange	Single Fitting, remote operating type
VAC	Fine Control Needle Valve			Symbol: VAC Letter: Black Index: Yellow	

.2 Water Fittings - Deck Mounted Single Hole Water Fittings:

Mark	Fitting Type	Hose Nozzle	Handle	Index Button	Configuration
DM1	Double cold (CW) and hot (HW) water	Serrated	Wrist Blade	Symbol: HW Letter: White Index: Red Symbol: CW Letter: White Index: Green	Rigid mount, gooseneck with vacuum breaker and ceramic disc cartridge

.3 Sinks (S):

Mark	Sink Type	Material	Fixture Type	Size
S-1	Single Bowl Counter mounted sink with drainage boards on both sides; Insert type	Epoxy Resin	DM1	Refer to Drawing A0.02 Sink Schedule
S-2	Single Bowl Counter mounted sink; Insert type	Epoxy Resin	DM1	Refer to Drawing A0.02 Sink Schedule
S-3	Single Bowl Counter mounted sink; Insert type	Epoxy Resin	DM1	Refer to Drawing A0.02 Sink Schedule
S-4	Double Bowl Counter mounted sink; Insert type	Epoxy Resin	DM1	Refer to Drawing A0.02 Sink Schedule
S-5	Single Compartment Scullery Sink; Insert type	Epoxy Resin	DM1	Refer to Drawing A0.02 Sink Schedule

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section includes provisions for manual operated interior roller shades, mounted between window framing, underside of window bulkhead.

1.2 RELATED REQUIREMENTS

.1 Section 06 08 99 –Rough Carpentry: Miscellaneous carpentry for wood blocking and grounds for mounting roller shades and accessories.

1.3 REFERENCE STANDARDS

.1 American Architectural Manufacturer's Association (AAMA):

.1 AAMA 611-98, Voluntary Specification for Architectural Anodized Aluminum

.2 American National Standards Institute (ANSI)/Window Covering Manufacturers Association (WCMA):

.1 ANSI/ WCMA A100.1-2010, Safety of Corded Window Covering Products

.3 American Society for Testing and Materials (ASTM):

.1 ASTM B429-02, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

.4 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S109-03 Flame Tests of Flame Resistant Fabrics and Films

1.4 SUBMITTALS

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

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit information for each type of product indicated including, but not limited to, the following:

.1 Styles, material descriptions, construction details, dimensions of individual components and profiles, features, and finishes.

.2 and mounting arrangements.

.3 Operating instructions

.2 Shop Drawings: Submit shop drawings indicating location and extent of roller shades including, but not limited to, the following:

.1 Elevations, sections, details, and dimensions not shown in submitted product data.

.2 Installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

.3 Samples:

.1 Verification Samples: Submit samples for verification of selected products as follows:

.1 Complete, full-size operable unit x 400 mm long minimum for each type of roller shade indicated.

.2 Single sample of shade material not less than 300 mm square, with specified treatments applied; mark top face of material.

.4 Schedule: Submit window shade schedule using same room designations as indicated on Drawings.

.3 Informational Submittals: Provide the following submittals when requested by the Consultant:

.1 Coordination Drawings: Submit coordination drawings comprised of reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items including, but not limited to, the following:

.1 Ceiling suspension system members and attachment to building structure.

.2 Ceiling mounted or penetrating items including light fixtures; air outlets and inlets; speakers; sprinklers; recessed shades; and special mouldings at walls, column penetrations, and other junctures of acoustical ceilings using joining construction.

.3 Shade mounting assembly and attachment.

.4 Minimum Drawing Scale: 1:100

.2 Certificates: Submit product certificates for each type of roller shade product, signed by product manufacturer stating that materials installed match performance requirements specified in this Section.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for operations and maintenance procedures, include name of original installer and contact information in accordance with Section 01 78 00 – Closeout Submittals and as follows:

.1 Methods for maintaining roller shades and finishes.

.2 Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.

.3 Operating hardware.

.2 Submit manufacturer's standard maintenance contract for review and consideration by Owner.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Flame Spread Rating: Provide roller shade panel materials with flame spread and smoke developed characteristics required by Authority Having Jurisdiction, as determined by testing identical products in accordance with CAN/ULC S109.

.2 Qualifications:

.1 Installer: Installer experienced and that has completed installations of roller shades similar in material, design, and extent to that indicated in this Section; submit proof of capabilities when requested by Consultant.

.2 Supplier: Obtain roller shades through one source from a single manufacturer, from a manufacturer approved supplier.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver shades in factory packages, marked with manufacturer and product name, fire test response characteristics, and location of installation using same room designations indicated on Drawings and in a window shade schedule.

1.8 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where roller shades are indicated to fit between other construction; coordinate fabrication schedule with construction progress to avoid delaying the work, and as follows:

.1 Allow clearances for operable glazed units' operation hardware throughout the entire operating range.

.2 Notify Consultant of discrepancies.

.2 Established Dimensions: Establish dimensions and proceed with fabricating roller shades without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

1.9 WARRANTY

.1 Manufacturer Warranty: Provide manufacturer’s warranty from commencing from date of Substantial Performance covering the following minimum requirements for materials:

.1 Shade Fabric: Ten (10) years

.2 Metal Finishes: Ten (10) years

.3 Shade Hardware: Ten (10) years

Part 2 Products

2.1 DESCRIPTION

.1 Mounting: Inside mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

1.1.1 Direction of Roll: Regular, from back of roller.

2.2 PERFORMANCE REQUIREMENTS

.1 Roller window shade when lowered has fabric taught and without sagging, with bottom of shade fabric straight and level.

2.3 ASSEMBLIES

.1 Manual Chain Operators: Continuous loop bead chain, clutch, and cord tensioner lift operator.

.1 Location of Operator: Left Hand as determined by user facing shade.

.2 Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.

.3 Lift Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.

.4 Loop Length: Length required to make operation convenient from floor level.

.5 Bead Chain Material: Continuous loop of #10 stainless steel bead chain or nickel-plated steel having a rated strength of 40 kg minimum to prevent chain breakage under normal operating conditions; and as limited by ANSI/WCMA A100.1 safety requirements, and as follows:

.1 Single chain operator with inertia brake mechanism capable of locking the shade panel at any point of travel.

.2 Chain drive operator that positively engages drive mechanism through internal profile configuration. Friction fitted engagement of the roller tube to drive mechanism will not be acceptable.

.3 Chain operator that prohibits operation by pulling on hem bar.

.6 Operating Function: Stop and hold shade at any position in ascending or descending travel.

.2 Materials

.1 Shade Fabric Non-PVC-coated fibreglass and as follows:

.1 Material Width: As indicated on Drawings.

.2 Fabric Openness Factor: 5% openness

.3 Material Colour: Black

.2 Roller Components:

.1 Roller Tube: One piece, extruded aluminum, 6061-T6 or 6063-T6, meeting the requirements of ASTM B429, or steel with galvanized or epoxy finish, and as follows:

.1 Protective Finish: AA-M12C22A21, medium matte anodic coating; clear coating 0.025 mm minimum in accordance with AMA 611. Roller tubes with mill finish are not acceptable.

.2 Tube Diameter and Thickness: As recommended by manufacturer for maximum allowable deflection of L/700.

.3 Tube Configuration: Tube profile with provision for mechanical engagement with the operator and drive assembly; and having channels to accept fabric spline attachment.

.4 Removable from brackets without hardware removal; non-metal components and self-lubricating.

.3 Fabric Spline: Extruded vinyl profile, welded to fabric panel, allowing removal and re-installation of shade fabric without removing the roller tube or hardware and having the following characteristics:

.1 Fabric bands or panels must be replaceable on site.

.2 Attachment of the fabric to the tube with double-sided adhesive tapes, adhesives, staples or rivets is not acceptable.

.4 Hem Bars and Hem Bar Pockets:

.1 Flat steel or aluminum profile; nominal 40 mm high having wall thickness engineered to suit loading requirements; slide hem bar into welded hem bar pocket with closed ends.

.3 Finishes: Anodized aluminum

.1 Colour: Clear anodized

.2 Metal Components Concealed From View:

.1 Aluminum: Mill finish

.2 Steel: Galvanized. Stainless steel acceptable.

1.1.1 Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings; removable design for access.

1.1.1 Mounting Brackets: Designed for continuous front or rear roll fascia across multiple shades without exposed fasteners, galvanized or zinc-plated steel fascia end caps, fabricated from steel finished to match fascia.

.4 Accessories:

.1 Fasteners: Non-corrosive fasteners as recommended by manufacturer.

Part 3 Execution

3.1 INSTALLATION

.1 Install roller shades level, plumb, square, true and according to manufacturer's written instructions. Allow clearances for window operation hardware.

3.2 SITE QUALITY CONTROL

.1 Replace damaged roller shades that cannot be repaired, to appear new before time of Substantial Completion.

3.3 ADJUSTING

.1 Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

.2 Adjust and set roller shade travel length of operator assembly on-site without disassembly of hardware to suit travel length of shade panel.

3.4 CLOSEOUT ACTIVITIES

.1 Cleaning: Clean roller shade surfaces after installation, following manufacturer's written instructions.

3.5 PROTECTION

.1 Raise roller shades fully until Substantial Completion to protect fabric from construction related activities.

END OF SECTION

Part 1 GENERAL

1.1 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

.1 Gas, air and vacuum cocks, faucets, tail pieces, strainers, traps, electrical outlets, non-integral sinks and drains.

1.2 RELATED REQUIREMENTS

.1 Section 09 21 16 – Gypsum Board Assemblies: Supply and installation of 1.214 mm sheet metal wall reinforcement.

.2 Section 11 53 13 – Fume Hoods: Placement of fume hoods on top of laboratory casework.

.3 Section 11 53 43 – Service Fittings and Accessories: Gas, water and electrical fittings common to laboratory casework and fume hoods.

.4 Division 22 – Plumbing: Plumbing rough-in and connection.

.5 Division 23 – Heating, Ventilation, and Air-Conditioning

.6 Division 26 – Electrical: Wire ways and devices, rough-in and connection.

1.3 REFERENCES

.1 ASTM International (ASTM)

.1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A240/A240M-14, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

.3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 CSA International (CSA)

.1 CSA O112.10-08, Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).

.3 Scientific Equipment and Furniture Association (SEFA):

.1 SEFA 2.3-2010, Installation of Scientific Laboratory Furniture and Equipment

.2 SEFA 3-2010, Work Surfaces

.3 SEFA 7-2010, Laboratory and Hospital Fixtures, Recommended Practices

.4 SEFA 8-2010, Laboratory Furniture, Casework, Shelving and Table Recommended Procedures

.4 National Fire Protection Association (NFPA):

.1 NFPA 30-2000, Flammable & Combustible Liquids Code

.2 NFPA 45-2000, Standard on Fire Protection for Laboratories Using Chemicals

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate layout and installation of blocking and reinforcement in partitions for support of laboratory casework with Section 09 21 16.

.2 Coordinate with Contractor to deliver laboratory casework to the spaces in which it is to be installed prior to removing the manufacturer's packaging.

.3 Coordinate delivery of steel components when site is clean and relatively dust-free area; the installer shall be responsible to maintain the storage area to the conditions outlined and to make good all damages that might occur to the material while in storage or during installation at no extra cost to the Owner.

.1 Coordinate connection of service fittings to building mechanical and electrical services with Division 22 – Plumbing and Division 26 – Electrical.

.4 Scheduling: Schedule completion of areas ready for laboratory furniture installation and delivery of laboratory furniture in conjunction with the Contractor to minimize storage, re-handling, and delays between delivery and installation.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for steel laboratory casework 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 Ontario, Canada.

.2 Indicate on drawings:

.1 Details of laboratory casework construction and related and dimensional position, with sections.

.2 Location of each casework unit.

.3 Location for roughing-in of plumbing, including sinks, faucets, strainers and cocks and electrical services.

.4 Samples:

.1 Submit duplicate samples of:

.1 Countertop material, 300 x 300 mm including external corner.

.2 Standard colour of cabinet finish on 300 x 300 mm steel sheet.

.3 Cabinet hardware.

.4 Plumbing brass and electrical outlets.

.2 Submit one base cabinet complete with cupboard and drawers minimum 1200 mm long, including specified bench top, splashback, end return and curb shelf.

.3 Submit wall case minimum 600 mm long..

.5 Test Reports:

.1 Include test reports by independent testing laboratories indicating results of furniture finish tests.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect steel laboratory casework 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 and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

1.7 MOCK-UPS

.1 Provide required Mock-Ups in accordance with Section 01 45 00 – Quality Control, and as follows:

.1 Free Standing Units: One full size, finished base cabinet complete with hardware, doors, and drawers, with work surface.

.2 Cantilevered Core Support System: One full size unit , finished base cabinet complete with hardware, doors, and drawers, with work surface and upper cabinets.

.3 Leg frame Table System: One full size, finished table frame unit with suspended base cabinets complete with hardware, doors, and drawers, with work surface and upper cabinets.

.4 Upper Cabinets: One full-size, finished wall cabinet complete with hardware, doors, and adjustable shelves.

1.8 QUALITY ASSURANCE

.1 Standards referenced in this Section indicate a minimum acceptable level of quality; additional provisions of this Specification take precedence over any standard usually followed by the manufacturer, regardless of manufacturer.

.2 Fabricate framing in a well equipped facility capable of producing the highest grade of scientific research type laboratory casework.

.3 Obtain cabinets through one source from a single manufacturer, coordinated with Section 11 53 13 and Section 11 53 43 so that all components fit with minimal site adjustment.

.4 Provide certification that furniture meets or exceeds the performance requirements described in SEFA 8.

.5 Install laboratory casework under full time supervision of an experienced foreman familiar with laboratory casework system, and related mechanical and electrical systems, who is in the full time employ of the laboratory casework manufacturer, or a contracted installer regularly used by the manufacturer.

1.9 GUARANTY/WARRANTY

.1 Provide a written guaranty/warranty, signed and issued in the name of the Owner, stating that components for the system installed will continue to be available for a period of not less than ten (10) years from Substantial Performance of the Work, and that the furniture installed will remain serviceable for a period of not less than two (2) years from date of Certificate of Substantial Performance.

.2 Guaranty/warranty shall cover repair or replacement for components having defects or nonconforming materials and workmanship including, but not limited to, the following:

.1 Ruptured, cracked, or stained coating materials; discolouration or lack of finish integrity; cracking or peeling of finish; delamination of plastic laminate or edge banding.

.2 Weld or structural failure; visible weld marks or discolouration.

.3 Slippage, shifts, or failures of connected components, including attachments to wall, floor, ceiling, or building structure that are not caused by building movement; warping or unloaded deflection of components.

.4 Sealant deterioration, shrinkage, or failure.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Metal Materials:

- .1 Galvanized steel sheet: commercial quality to ASTM A653/A653M with Z275 zinc coating.
- .2 Stainless Steel: Type 316, conforming to ASTM A167, with #4 satin finish.
- .3 Bolts and Anchor Bolts: To ASTM A307.
- .4 Steel Sections and Plates: To CAN/CSA G40.21, Grade 300W.

.2 Glass Materials: Sheet glass conforming to CAN/CGSB 12.3 and as follows:

- .1 Framed Glass Swing Doors: Nominal 4 mm thick securely attached to swing doors.

.3 Miscellaneous Materials:

- .1 Silicone Sealant: One part silicone conforming to CAN/CGSB 19.13; colours to match casework colours.
- .2 Asphalt coating: Fibrated emulsified asphalt conforming to CAN/CGSB 37.28.

2.2 COUNTERTOP AND WORKSURFACE MATERIALS

.1 Poured epoxy: apply 100% solid epoxy resin compound at rate which will produce finished thickness of not less than 1.25 mm thick, with surface ground to dull black, non-reflecting surface which is free of minute pin holes, air bubbles and pores. Use 0.25 mm thick coating for concealed and unfinished surfaces. Epoxy finished surfaces to conform to following minimum requirements:

- .1 Tensile strength: 20 to 30 MPa.
- .2 Flexural strength: 700 MPa.
- .3 Compressive strength: 100 MPa.
- .4 Impact strength: 4 J.
- .5 Hardness: 100 Rockwell.
- .6 Linear shrinkage on curing: 0.4%.
- .7 Water absorption: 0.1%
- .8 Good flexibility, hard abrasion, impact and thermal shock resistant.
- .9 Resist immersion in water, and heat up to 100 degrees.
- .10 Resistance against alkaline substances, detergents and coolants.
- .11 Resistance to acid fumes, acid solutions, greases and oils.
- .12 Resistance to wide range of corrosive chemicals and solvents.
- .13 Will not support mould or fungus growth.

2.3 COUNTERTOP AND WORKSURFACE FABRICATION

.1 Fabricate laboratory countertops and splashbacks as indicated.

.2 Fabricate countertop and splashback sections in as long a length as practicable.

.3 Cut holes for fittings, accessories, and equipment. Round or chamfer exposed edges and corners of cutouts.

.4 Sink Cut-outs: Smooth and uniform without saw marks with the top edge bevelled; bottom edge finished smooth with the edge broken to prevent sharpness and corners having radius not less than 19 mm to suit sink specified in Section 11 53 43.

.5 Finish exposed edges and surfaces in same manner as specified for working surface of countertop material.

.6 Make allowances around periphery and where fixed objects pass through or project into countertop material to permit normal movement without restriction.

.7 Joints: field welded or mechanical watertight.

2.4 LEG FRAME SYSTEM

.1 Die formed, rigid interlocking structural leg frame system providing services through removable cover panels, and requiring no special tools for assembly, with fixed height legs and 10 mm Ø levelling bolt having 35 mm Ø nylon glide and 100 mm high stainless steel boot; shelf brackets adjustable in 25 mm increments; suspension system that cabinets and components to be easily removed and replaced.

.2 Wall Channels: 38 mm wide x 19 mm deep having continuous open slot with edges turned inward, providing for attachment of frames or cabinets at any point along the length of the channel using spring loaded nuts and accessories; cut required lengths of wall channel in the shop, and provide 4 holes in the back at points of attachment to the building wall reinforcement for full height channels and 2 holes for channels at windows.

.3 Bench Frame Members: Channels or rectangular tubes of 38 mm x 38 mm with provision for attachment of cabinets, work surfaces, other framing and bracing, and mechanical and electrical services with cold formed steel channel nuts and accessories.

.4 Provide a continuous closure at the base of the service space both where there are cabinets and where there are none.

.5 Provide removable panels, with finger holes for easy removal, above the base closure to enclose the service space where it is not closed by cabinets.

.6 Close ends of service strip with one (1) piece closure panel from floor to work surface where enclosed piping does not continue beyond the end of the service space; site cut or notch panels to fit piping where piping continues.

.7 Make closure panels of minimum 1.214 mm thick steel for metal casework with same finish as cabinets.

.8 Provide removable 38 mm x 38 mm steel rails for frames below work surface level where no cabinets are located; secure to horizontal leg frames with spring loaded nuts and tabs so that members are in same plane as the leg braces to which they are attached; alternate attachment system, provide 5 holes in leg frame to allow adjustment of rails.

.9 Provide 1.897 mm steel channels for attachment to tops of leg frames to support work surfaces; front and back horizontal support rails from 2.657 mm steel spaced between frames for the support of lower cabinets; secure channels to tops of cabinets of lower modules using interlock with horizontal support rails to provide easy horizontal adjustment and relocation of modules and secure enough to prevent accidental removal.

.10 Provide sheet metal closures having minimum 1.214 mm core thickness to close gap between adjacent leg frames at internal corner junctions; finish same as for cabinets.

.11 Rigidly brace frames of peninsular units, particularly where frames extend above work surface; above bench framing shall be as indicated on Drawings and have double vertical standards.

.12 Make brackets for open shelves and support for upper cabinets of minimum 2.657 mm steel sheet; form brackets and punch holes for fasteners prior to finishing and finish same as for frames; brackets shall fit standards and be securely fastened to shelves or upper cabinets.

.13 For large sinks provide a support frame below sink, spanning two (2) steel rails between leg frames, mechanically fastened.

2.5 CANTILEVERED CORE SUPPORT SYSTEM

.1 Die formed, rigid interlocking structural core frame system anchored to floor providing services through removable cover panels, with fixed vertical frames and 10 mm Ø levelling bolt and 100 mm high stainless steel boot; shelf brackets adjustable in 25 mm increments; cantilevered 300 mm wide suspension system that cabinets upper cabinets and components to be easily removed and replaced.

.2 Bench Frame Members: Channels or rectangular tubes of 38 mm x 38 mm with provision for attachment of cabinets, work surfaces, other framing and bracing, and mechanical and electrical services with steel channel nuts and accessories.

.1 Provide 38 mm x 38 mm steel rails below work surface level where no cabinets are located; secure to core post frames with spring loaded nuts and tabs so that members are in same plane as the leg braces to which they are attached; alternate attachment system, provide 5 holes in leg frame to allow adjustment of rails.

.2 Provide 2.657 mm steel sheet steel brackets and channels for attachment to tops of frames to support work surfaces; front and back horizontal support rails from 2.657 mm steel spaced between frames for the support of lower cabinets; secure channels to tops of cabinets of lower modules using interlock with horizontal support rails to provide easy horizontal adjustment and relocation of modules and secure enough to prevent accidental removal.

.3 For sinks provide a cantilevered support frame below sink, spanning two (2) steel rails between leg frames, mechanically fastened.

.3 Above Counter Shelf Posts/Channels: 38 mm wide x 38 mm deep having continuous open slot with edges turned inward, providing for attachment of frames or cabinets at any point along the length of the channel using steel channel nuts and accessories; cut required lengths of wall channel in the shop, and provide 4 holes in the back at points of attachment to the building wall reinforcement for full height channels and 2 holes for channels at windows.

.1 Make brackets for open shelves and support for upper cabinets of minimum 2.657 mm steel sheet; form brackets and punch holes for fasteners prior to finishing and finish same as for frames; brackets shall fit standards and be securely fastened to shelves or upper cabinets.

.4 Rigidly brace frames of units, above bench framing shall be as indicated on Drawings and have double vertical standards.

.5 Provide a continuous closure at the base of the service space both where there are cabinets and where there are none.

.6 Provide removable panels, above the base closure to enclose the service space.

.7 Close ends of service strip with one (1) piece closure panel from floor to work surface where enclosed piping does not continue beyond the end of the service space; site cut or notch panels to fit piping where piping continues.

.8 Make closure panels of minimum 1.214 mm thick steel for metal casework with same finish as cabinets.

.9 Provide sheet metal closures having minimum 1.214 mm core thickness to close gap between adjacent leg frames at internal corner junctions; finish same as for cabinets.

2.6 CABINETS

.1 Freestanding Base Cabinets: Freestanding cabinets fabricated from cold rolled steel and having 100 mm high x 76 mm deep toe space and levelling bolts concealed with colour matching plugs removable back panels for access to service space; provide a partial 230 mm high back panel to accommodate plumbing for sink units.

.2 Suspended (Under Counter) Base Cabinets: Suspended cabinets fabricated from cold rolled steel and having suspension system compatible with leg frame assemblies removable back panels for access to service space; provide a partial 230 mm high back panel to accommodate plumbing for sink units. Wall Cabinets: Similar to base cabinet construction, with mounting hardware for attachment to wall brackets.

.3 Drawers: Fully interchangeable, reinforced to suit loads and having integral stops to prevent accidental pull-out and drawer slides, rubber mutes and other hardware as listed on drawings.

.4 Doors: Fully interchangeable, one piece construction metal doors reinforced and sound deadened and equipped with hinges and catches, rubber mutes and other hardware as listed on drawings; glass doors as listed in 2.1.2 above.

.5 Shelves: Adjustable in 13 mm increments, pull-out shelves suspended on same as standard drawers, metal shelves formed with 25 mm edges turned down and back.

.6 Lined Acid Storage Cabinets: Cabinet to match construction of wall and base cabinets having 5 mm high-density polyethylene lining with raised edges to contain spills and removable back panel held in place with stainless steel screws; connect vent cabinet to fume hood extraction system; provide one (1) adjustable, perforated stainless steel shelf; label doors of unit with WHMIS corrosive warning and caution labels acceptable to Health Canada requirements, and install two (2) louvres in each door face; materials known to deteriorate in long-term use will not be acceptable.

.7 Insulated Solvent Storage Cabinets: Meeting requirements of NFPA 30 and NFPA 45, ULC labelled; cabinet to match construction of wall and base cabinets having 50 mm thick insulated double wall construction and 50 mm deep spill containment pan; doors equipped with three point self latching handle and self closing mechanism; vent cabinet equipped with fire baffles and vent covers, connect vent cabinet to fume hood extraction system; provide one (1) adjustable galvanized steel shelf; label doors with WHMIS “FLAMMABLE KEEP FIRE AWAY” label acceptable to Health Canada requirements, and finish cabinet in safety yellow.

2.7 WALL BRACKETS

.1 Upper cabinet and shelf brackets, surface mounted, designed to support a minimum of 365 kg/m2 with a maximum spacing of 812 mm O/C, fabricator shall provide structural calculations and certification that support spacing meets manufacturers' recommended maximum loading for shelf brackets and supports.

2.8 TABLE FRAMES AND APRON PANELS

.1 Steel frames constructed from 95 mm high "C" channel sections; steel legs fabricated from 50 mm x 50 mm seamless tubing through bolted to table frame and having levelling bolt and PVC; provide steel end caps to match apron frames and supports.

2.9 CABINET HARDWARE

.1 Heavy duty cabinet hardware meeting or exceeding the requirements of ANSI 156.9, or greater standard as required by the recommended Door, Drawer and Shelving physical strength performance tests listed in SEFA 8.

.2 Door and Drawer Pulls:

.1 Flush aluminum set minimum 15 mm into face, to manufacturer's standard.

.3 Hinges:

.1 Chrome plated steel, 1.897 mm core metal thickness 3 or 5 knuckle type, to manufacturer's standard.

.2 Acid and Solvent Storage Cabinets: Stainless steel, 1.897 mm core metal thickness five knuckle type, overlay hinges to manufacturer's standard.

.4 Drawer Slides:

.1 Rail mounted, all ball bearing, full extension drawer slides with progressive movement and over travel; rated for 45 kg capacity, zinc finish; rated for the following capacities:

.1 45 kg capacity for drawer width ≤ 812 mm

.2 91 kg capacity width ≤ 1067 mm

.2 Drawer bottom mounted runner, full extension, rated for 45 kg capacity, epoxy finished, to manufacturer's standard.

.3 Steel drawer sides having integral slides, full extension, rated for 45 kg capacity, epoxy finished to manufacturer's standard.

.5 Shelf Clips: Die formed steel, and zinc plated; fully engage in adjustment holes in metal case work, located on 13 mm centres, to manufacturer's standard.

.6 Work surface connectors: fasteners, bright zinc coated to manufacturer's standard.

.7 Work surface to service strip connectors: 19 mm x 50 mm x 3 mm bright zinc plated straps with screw holes at each end.

.8 Spring Loaded Nuts:

.1 Spring nuts designed for insertion at any point in a wall channel or leg frame, with spring retainer to hold nut in position; one size throughout, bright zinc finish.

.9 Screws, for use at site in assembly of tops and for securing cabinets, shelving, and other components:

.1 Stainless steel round-head wood or machine screws, to suit application, Robertson head, 4 mm minimum shank diameter, all one size.

.2 Use captive star washers, compression inserts or similar locking devices for all screwed connections using machine screws or bolts.

.10 Other Hardware: Stainless steel to manufacturer's standard.

2.10 FABRICATION

.1 Fabricate laboratory furniture to meet or exceed the recommended physical strength performance tests listed in SEFA 8.

.2 Steel Casework Bodies: Cold rolled steel having the following minimum thicknesses:

Gauge	Component
0.912 mm	Drawer bodies, shelves, door and drawer liners, and removable backs.
1.214 mm	Cabinet gables, tops and bottoms, toe kicks, outer door and drawer front panels, table frames, filler panels, and sloping tops.
1.519 mm	Top and intermediate channels and table legs , leg frames, posts and shelf brackets.
2.657 mm	Drawer suspension and hinge plates and leg frame support rails.
2.657 mm	Shelf brackets.
3.02 mm	Cabinet leveller supports and leg frame structural supports.
Use galvanized steel in wet areas and bases of cabinets, use stainless steel in acid or alkali areas.	

.3 Fabricate work of this Section in accordance with the reviewed submittals.

.4 Make welds smooth and remove flux and splatter; welding shall be performed by properly licensed welders in accordance with CSA W59.

.5 Fabricate cabinets as fully enclosed, self-contained units, factory assembled and finished, with each unit rigid and self-supporting, suitable for individual removal for relocation or access to services, without disturbance or modification of adjacent units.

.6 Control variations in size of units in relation to method of support and attachment so that units of the same nominal size are fully interchangeable, and make all cabinet sub-assemblies (doors, drawers, track and back panels), which are nominally identical units interchangeable in the site without modification.

.7 Make shelves and drawers as deep as the cabinet depth permits, with adjustable supports for shelving within cabinets.

.8 Position handles on cabinet doors in the corner away from the hinge and nearest the work surface.

.9 Minimize the extent of exposed mechanical fastenings.

2.11 CABINETS

.1 Construct cabinet bodies of sheet metal, flanged and returned at exposed gables to receive flush mounted drawer fronts and doors.

.2 Flange and set back top rails and bottom panels.

.3 At base cabinets include 38 mm long levelling screw for adjusting to floor variations, in gussets and accessible through plugged openings in bottom.

.4 Include removable backs, knee space panels or access doors where piping or wiring occur.

2.12 DOORS

.1 Fabricate doors of double pan construction, 19 mm thick, telescoped inner pan into outer pan with exposed vertical edge formed into channel shape having returned lip over inner pan, offset to receive lip.

.2 Fill door panels with fibrous board or paper waffle sound deadener.

.3 Provide reinforcement for hardware attachment to inner pan and conceal. Install hardware.

.4 Bevel inside edge of cutout in front panel of glass door.

.5 Set glass in continuous rubber gasket between panels.

2.13 DRAWERS

.1 Fabricate drawer fronts of double pan construction, 19 mm thick, telescoped inner pan with exposed vertical edge formed into channel shape having return lip over inner pan, offset to receive lip.

.2 Fill front panels with fibrous board or waffle paper.

.3 Weld drawer bodies to front through flanges on sides and bottom, and back through flanges at rear.

.4 Extend flanges outward or downward, top of side and back rolled. Cove corners to 12 mm radius.

.5 Include reinforcements for hardware and install finish hardware.

2.14 SHELVES

.1 Form shelves of steel sheet with front and rear edges flanged down 19 mm and hemmed back at 30 degrees to underside of shelf.

.2 Support cabinet shelves with shelf clips inserted in slots in front stile and in formed channel in back.

.3 Notch flanges at sides to match, and engage with embossments on side panels.

2.15 GLASSWARE PEG BOARD AND EQUIPMENT BACKING BOARD

.1 Fabricate pegboards using same laboratory grade epoxy resin materials used for work surfaces, finished front, back, and edges, having pegs fabricated from black polypropylene rod with drip at base of peg, 10 mm Ø pegs x 125 mm long at 100 mm centres horizontal and vertical both ways and as follows:

.1 Provide a welded, Type 304, 1.214 mm, #4 finish stainless steel trough sloped to one end with a tailpiece and plastic tubing to provide drainage into the sink at the bottom of each pegboard.

.2 Provide hardware and framing to attach boards to wall channels and to ends of island upper framing.

2.16 ACCESSORIES

.1 Gas cylinder wall bracket: Cast aluminum or powder paint coated hot rolled steel construction bracket with nylon strap and buckle.

.2 Gas Cylinder Bench Bracket: Cast aluminum or powder paint coated hot rolled steel construction bracket with nylon strap and buckle.

.3 Valves, Sinks and Fixtures, and Electrical Fittings: Locations and types as indicated on drawings, configurations as listed in Section 11 53 43.

2.17 FINISHING

.1 Grind and polish spot weld marks from exposed surfaces.

.2 Provide a Manufacturer’s standard Laboratory Grade finishing system conforming with SEFA 8 – Part 8.0 Cabinet Surface Finish Tests and the following;

.1 Finish that results in no Level 3 condition results.

.3 Pre-treat and clean metal surfaces with iron phosphate and de-ionized water rinse as a minimum requirement for good finish coat bond; finish coat using 2 coats thermosetting epoxy or polyester to all exposed surfaces, semi-gloss finish.

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 steel laboratory casework 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 Fabricate and install laboratory casework to meet or exceed the following tolerances:

.1 Fabricated width, depth and height: +0 mm; -1.5 mm.

.2 Casework and work surface level and plumb: 3 mm in 3050 mm.

.3 Work surface joints: hairline and level to adjacent surfaces.

.4 Alignment with other components: -0; +1.5 mm.

.2 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, level and rigid:

.1 Use pilot holes, properly sized for the screw size, and screwdrivers (not hammers) to install all screws.

.2 Use boring jigs, mortising tools and other special equipment and appliances as required to install work properly and maintain tolerances required for inter-changeability of components.

.3 Finish cut edges to match factory applied finish in appearance and serviceability if any site cutting is required.

.3 Install casework with no variations in flushness of adjoining surfaces; use concealed shims, scribe and cut for accurate fit where casework abuts other finished work:

.1 Provide filler strips, scribe strips, and mouldings in finish to match casework face.

.2 Install casework without distortion so doors and drawers fit openings and are aligned.

.3 Complete installation of hardware and accessories as indicated.

.4 Support wall cabinets on continuous galvanized steel hanging brackets.

.5 Bolt adjoining cabinets together, maximum width of joint 1 mm.

.6 Leg Frame Casework Installation:

.1 Commence framing installation with wall channels; then install service strip framing and framing required to support tops with sinks.

.2 Seal along base/floor of service space with a bead of silicone sealant to prevent liquids or water from entering service space or wall behind.

.3 Install the remaining framing after installation of service pipes and conduits.

.4 Install wall channels at each modular leg frame location or as shown on the drawings.

.5 Provide double wall channels at internal corners.

.6 Suspend casework in leg frame system in accordance with reviewed shop drawings.

.7 Cantilevered Casework Installation:

.1 Commence framing installation with floor channels; then install service strip framing and framing required to support tops and above counter shelving supports; provide framing required to support tops with sinks.

.2 Seal along base/floor of service space with a bead of silicone sealant to prevent liquids or water from entering service space or wall behind.

.3 Install the remaining framing after installation of service pipes and conduits.

.4 Provide double wall channels at internal corners.

.5 Suspend casework in cantilevered system in accordance with reviewed shop drawings.

.8 Freestanding Casework Installation:

.1 Fasten base cabinets to adjacent units and to metal wall backing behind gypsum board taking care not to strip screw or backing plate.

.2 Replace screw in new location near original installation where screws are over-tightened or stripped.

.3 Do not use explosive driven fasteners where attachment to floor is required.

.9 Wall Mounted Casework Installation:

.1 Fasten wall brackets at ends and not more than 610 mm o/c, with toggle bolts through metal backing behind gypsum board.

.2 Secure open shelves and upper cabinets to metal shelf brackets with wood/metal screws into the underside through pre-drilled holes in the brackets.

.3 Secure upper cabinets to metal brackets fastened to the wall channels below the cabinet, and with clips into the wall bracket at top of cabinet.

.4 Confirm that wall channels are securely fastened to metal wall reinforcing supports.

.10 Work Surfaces:

.1 Scribe to abutting surfaces where required due to site conditions.

.2 Only factory prepared site joints, located in accordance with reviewed shop drawings are permitted.

.3 Secure site joints in the same manner as in the factory.

.4 Secure work surfaces to casework and equipment components with materials and procedures recommended by the manufacturer.

.5 Centre end joints in service strips and work surfaces over frames.

.6 Align joints in work surfaces and backsplashes with joints of service strip.

.7 Align joints in work surfaces and service strips with splines, seal with silicone sealant applied before the joint is closed and draw together with joint fasteners; do not glue splines, remove excess sealant promptly, correct joints that are not hairline width and flush.

.8 Connect service strip panels and work surfaces to intermediate frames using screws.

.9 Place a bead of silicone sealant on the edge prior to placing work surface in position, to seal the joint with the service strip when the top is in position and secured.

.11 Repair or remove and replace defective work, as directed by Departmental Representative upon completion of installation.

.12 After installation, adjust operating hardware.

.1 Adjust casework and hardware so doors and drawers are centred in openings and operate smoothly without warp or bind.

.2 Lubricate operating hardware as recommended by manufacturer.

.13 Touch up factory applied finishes to restore damaged or soiled areas.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.1 Touch up marred or abraded finished surfaces.

.2 Wipe down surfaces to remove fingerprints and markings.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel laboratory casework installation.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 It is the responsibility of the Constructor to make requirements for affected related specification sections, and any requirements for alternates and sub situations available to Subcontractors:

- .1 Subcontractors to receive a complete set of Documents for preparation of their Bids, and to provide a clear understanding of the complete scope-of-work for the Project.
- .2 Failure to provide required information to Subcontractors during the bid and Construction Phases of the Work will not relieve the Constructor of their responsibility for coordination of the affected Work.
- .3 Constructor is responsible for any additional costs to the Contractor arising from Subcontractors not receiving a complete package of Documents.
- .4 Provide complete coordination between Mechanical Divisions to attain a complete and functional building system; Mechanical Divisions include, but are not limited to, the following:
  - .1 Division 21 – Mechanical Common Requirements
  - .2 Division 21 – Fire Suppression
  - .3 Division 22 – Plumbing
  - .4 Division 23 – Heating, Ventilation, and Air Conditioning
  - .5 Division 25 – Integrated Automation
- .5 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances:
  - .1 Comply with the National Building Code
- .6 Include costs to obtain permits and to pay for fees and charges, including inspection charges, by Authorities Having Jurisdiction that issue permits; coordinate related inspections; permits, fees, and inspections include, but are not limited to the following:
  - .1 Plumbing and Gas
  - .2 HVAC
  - .3 Sprinklers and Fire Protection
  - .4 Boilers
- .7 Documents for the Project, including Specifications and Drawings, are generally diagrammatic and approximately to scale unless specifically detailed otherwise; the establish scope, material, and installation quality, and are not considered as detailed installation instructions.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work:

.1 Drawings and Specifications: Drawings and specifications are complementary to each other; and what is called for by one is binding as if called for by both and as follows:

.1 Examine Contract Documents including drawings and specifications, and work of other trades before starting Work and verify that Work can be satisfactorily completed without changes to the building.

.2 Departmental Representative will provide a clarification to identified discrepancies between drawings and specifications that leave the Contractor in doubt as to the true intent and meaning of the documents as follows:

.1 During Bid Period: A written Addendum will be issued to address a written request for clarification

.2 During Construction: A Construction Communication will be issued to address a written request for information

.3 Departmental Representative will respond to Requests for Interpretation and determine the requirements for clarification based only on variances contained in the documents as follows:

.1 Clarification based on information and not contained in the documents or in manufacturers written literature will be regarded as a change to the Work

.2 Clarification will include effects or influence of other specified products, adjacent construction, adjacent finishes, and methods of construction.

.3 Clarification issued during Construction Phase that affects the cost of the Work will be regarded as a Change to the Work.

.4 Coordinate installation of the Work with manufacturer's recommended installation details and procedures, supplemented by requirements of Contract Documents; provide adequate access space for maintenance and service of equipment and systems.

.5 Coordinate location of access to cleanouts, valves, equipment, and duct access doors above continuous ceilings; coordinate access panel and door requirements with Section 08 31 00.

.6 Coordinate installation of Work with adjacent work by others in accordance with requirements listed in Section 01 73 00 and as follows:

.1 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space; remove and replace improperly installed equipment as determined by Departmental Representative

.2 Refer to electrical, mechanical, structural and architectural drawings when setting out work and coordinate with other applicable components of the Work when setting out locations for ductwork, equipment, and piping so that conflicts are avoided and symmetrical even spacing is maintained.

.3 Provide coordination drawings showing the work of other trades and contractors involved in areas of potential conflict or congestion at no additional cost to the Contract.

.4 Coordinate dimensional details with applicable architectural and structural drawings.

.5 Full size and detailed drawings will take precedence over scale measurements from drawings when laying out the Work.

.6 Coordinate requirements of, and connect to, equipment specified in other Sections, and to equipment supplied and installed by other contractors or by Departmental Representative; uncrate equipment, assemble, move in place, and install complete, start-up and test; refer to Division 01 for pre-purchased equipment and equipment furnished by other Divisions.

.7 Declarations: Coordinate declaration of Substantial Performance and Total Performance with requirements of the General Conditions and Supplementary Conditions of Contract and with Section 01 77 00.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for mechanical equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 Where stated in respective specification sections, submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, 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: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.5 Identify materials and equipment submittals by listing manufacturer, trade name, and model number, and as follows:

.1 Detailed drawings of bases, supports, operating weight 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.

.6 Include copies of applicable brochure or catalogue material.

.7 Do not assume that applicable catalogues are available in Consultants office.

.8 Maintenance and operating manuals will not be considered as suitable submittal material.

.9 Leave space on shop drawing to accommodate Consultants review stamp.

.10 Clearly mark each shop drawing with identical name or number where equipment is identified by name or number on drawings or in specifications.

.11 Clearly identify dimensional and technical data sufficient to verify that equipment meets specified requirements.

.12 Clearly identify wiring, piping, service connection data and motor sizes.

.13 Clearly mark each submittal sheet using arrows, underlining, or circling to indicate differences between specifications and options proposed for use in the Work, such as differences in sizes, types, model numbers, rating, capacities, and similar criteria.

.14 Specifically note specified features included as a part of the submittal, such as special tank linings, pump seals, materials or painting.

.15 Strike out non-applicable material.

.6 Review shop drawings prior to submittal to Consultant certifying that:

.1 Site measurements are verified and correct.

.2 Site construction criteria, materials, catalogue numbers and similar data are coordinated with shop drawings and requirements of the Work.

.3 Certify review of each shop drawing by placing Subcontractor’s and Constructor’s review stamps, date and signatures of responsible persons.

.4 Verify installed materials and equipment meet specified requirements where shop drawings are not provided to Consultant for review.

.7 Use of Metric Units and Conversions in Submittals:

.1 Units expressed in these documents are written in Systems International (SI) Metric Units; soft metric conversions are used throughout.

.2 Submit shop drawings and maintenance manuals in SI Units; use same SI Units for submittals as stated in specification or drawings.

1.4 RECORD DRAWINGS

.1 Provide final record (as-built) drawings in digital format (AutoCAD) and Meet the requirements of Section 01 78 39 – Project Record Documents.

.2 Suitably store and protect drawings on site and make available at all times for inspection.

.1 Site records:

.1 Contractor to produce 1 set of reproducible mechanical drawings and create a 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.

.5 Drawings to show inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.

.6 Show locations of access doors and panels and identify the equipment and components that they serve.

1.5 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 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.5 Submit copies of as-built drawings for inclusion in final TAB report.

1.6 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data of mechanical equipment for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems 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.

.5 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.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.

1.7 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.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 head gasket set for each heat exchanger.

.4 One glass for each gauge glass.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set. Upon handover, contractor to replace all filters utilized during start-up and construction in all air handling equipment.

.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.

1.8 WARRANTY

.1 Provide a written warranty stating that Work executed in this Contract will be free from defective workmanship and materials for a period of one (1) year starting from the date of substantial performance of work in accordance with the requirements specified in Section 01 78 00.

.2 Warranty makes provision for repair or replacement of any Work that fails or becomes defective during the term of the warranty, providing the operating and maintenance instructions have been complied with by the Departmental Representative.

.3 Duration of the warranty specified does not, in any way, supplant any other guaranties or warranties provided under the Contract for individual pieces of equipment or systems having a longer period provided by Manufacturers or as called for in the project documents.

.4 Unless specified otherwise, Departmental Representative will be responsible for routine maintenance requirements as required in the manufacturer’s instructions, and will be responsible for supplying filters, grease and belts and other consumables required for routine maintenance.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect materials 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FACTORY APPLIED FINISH PAINTING

.1 Apply prime and final paint coats to equipment and materials supplied as part of this division.

.2 Use heat resistant paint where conditions require.

.3 Protect factory finished equipment during construction, and clean at completion of work.

.4 Field Painting:

.1 After equipment has been installed and piping and insulation is completed, clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted.

.2 Touch up any damage to prime and final coat resulting from shipping or installation.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Examination of Existing Conditions

.1 Visit and examine the site and note characteristics and features affecting the Work before submitting Bid.

.2 Report discrepancies in writing to Departmental Representative prior to Bid closing.

.3 No allowances will be made for difficulties encountered or expenses incurred arising from conditions of the site or existing items that are readily visible or known to exist at the time of Bid.

.4 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

3.2 CUTTING AND PATCHING

.1 Coordinate requirements of the Work with other Divisions.

.2 Coordinate locations of mechanical penetrations and sleeves through concrete floor structure including slabs, beams, purlins and girders; coordinate sleeving locations with other trades and conditions noted on site.

.1 Contractor will prepare coordination drawings for each floor level of the building indicating requirements of all trades penetrating concrete floor construction.

.2 Contractor to obtain sign-off from affected mechanical subtrades having penetrations and sleeves before submitting shop drawings to Departmental Representative for review

.3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

.5 Provide inserts, holes and sleeves, cutting and fitting required for mechanical work; relocate improperly located holes and sleeves.

.6 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.

.7 Obtain written approval from Departmental Representative before drilling, coring, cutting or burning structural members; verify that post tensioned or pre-stressed strands are located accurately and avoid cutting or damaging these elements with an adequate margin of safety.

.8 The Contractor is responsible to patch and make good building where damaged from equipment installation, improperly located holes and similar criteria.

3.3 EXCAVATION AND BACKFILL

.1 Confirm service invert elevations and locations prior to starting work, set grades to suit inverts.

.2 Grade the bottom of trench excavations as required.

.3 In firm, undisturbed soil, lay pipes directly on the soil.

.4 In rock and shale, excavate to 6" (150 mm) below and a minimum of 8" (200 mm) to either side of the pipe, and backfill to the required invert with granular "A" material compacted to minimum 95% Standard Proctor Density.

.5 Prepare new bedding under pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls and at manholes and catch basins. Compact to maximum possible density and support the pipe by 8" (200 mm) thick reinforced concrete cradles spanning full length between firm supports. Install reinforcing steel in the cradles or construct piers every 7.87' (2.4 m) or closer, down to solid load bearing strata. Provide a minimum of one (1) pier per length of pipe. Use the same method where pipes cross.

.6 Where excavation is necessary in proximity to and below the level of any footing, backfill with 2,000 psi (13,800 kPa) concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the Consultant.

.7 Provide support over at least the bottom one-third (1/3) segment of the pipe in all bedding methods. Shape the excavation to fit pipe hubs, couplings and similar items and ensure even bearing along the barrels.

.8 Keep walls of trenches straight to at least 18" (450 mm) within the pipe design limits. Have excavations inspected at least once a week by authorities. Break-up rocks and boulders and remove these by drilling and wedging. Do not use blasting unless specifically approved by the Consultant.

.9 Before backfilling, test work for leakage and arrange for the work to be inspected by the Consultant. Remove all shoring during backfilling.

.10 Backfill trenches within the building with clean sharp sand in individual layers of maximum 6" (150 mm) thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 12" (300 mm) above the top of the pipe. Hand or machine compact the balance up to grade.

.11 Do not use water for consolidation or during compaction of backfill.

.12 Fill all depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay all costs required to make good all damage caused by settlement.

.13 Dispose of surplus excavated materials.

.14 Do pumping as required to keep excavations free of water.

.15 Engage the services of an independent Soils Testing Agency to test the final backfill compaction density of each backfilled location. Ensure backfill is compacted to the satisfaction of the Testing Agency and in accordance with the Specification. Prior to applying for a Certificate of Substantial Completion of the Work, submit copy of Testing Agency's report to the Consultant for review. Include a copy of the report in each operating and maintenance instruction manual.

3.4 USE OF PERMANENT SYSTEMS FOR TEMPORARY HEAT

.1 Coordinate requirements for use of permanent heating systems for temporary heat in accordance with Section 01 51 00; do not use permanent system for temporary heating purposes without written permission from Departmental Representative; protect and restore permanent systems as specified in Section 01 51 00.

.2 Provide a proposed temporary heat agreement for Departmental Representative to review prior to use of permanent building systems for temporary heat; agreement includes payment schedules for utilities, spare parts listings, and confirmation of warranty.

.3 The terms of warranty are not modified by the use of permanent systems for temporary heat; equipment manufacturers certify that equipment is in "new" condition at start of warranty period, and as follows:

.1 Block-off system components not required for temporary heat in accordance with manufacturer’s requirement to maintain warranty.

.2 Thoroughly clean and overhaul permanent equipment used during construction period, replace worn or damaged parts before final inspection.

.3 Operate heating systems under conditions that allow no temporary or permanent damage.

.4 Operate with proper safety devices and controls installed and fully operational.

.5 Operate systems only with treated water as specified.

.6 Air systems may not be used for temporary heating.

.7 Provide alarm indicating system failure; connect alarm to independent alarm company system.

.8 Replace mechanical seals, regardless of condition, with new mechanical seals where pumps are used for temporary heating prior to Total Performance of the Work.

.9 Avoid thermal shock to heating system during planning, construction and operation of temporary heating system.

.4 Review temporary heating procedures with Departmental Representative as follows:

.1 Obtain acceptance by Departmental Representative for thermal insulation work and automatic control equipment associated with use of permanent heating system for temporary heat.

.2 Obtain approval from Departmental Representative and authority having jurisdiction before use of permanent heating system for temporary heat.

3.5 EXISTING SERVICES

.1 Maintain liaison with Departmental Representative to interrupt, re-route, or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Do not shut down or make connections to any existing service without written permission from the Departmental Representative.

.3 Confirm elevations and locations of existing services prior to and during excavation.

.4 Route pipes, ducts, conduits and other services to avoid interference with existing installation.

.5 Cut back and cap existing services not being used, so that finished Work presents a neat and clean appearance.

.6 Contractor shall be responsible for any damage to existing systems, including insulation and coverings, when making connections.

.7 Existing facility to be in operation throughout the duration of Construction, with minimum length of system shut-down periods.

.8 Include overtime work for tie-in piping, ductwork, or wiring at night or on weekends.

.9 Provide Departmental Representative with as-built drawings of site services in accordance with Section 01 78 00; dimensioned to grid lines, building exterior walls or other permanent building component.

3.6 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance; leave factory covers in place; take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.

.4 Clean piping, ducts and equipment of dirt, cuttings and other foreign substances in accordance with Section 01 74 11.

.5 Protect bearings and shafts during installation: Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling unit.

3.7 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.8 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.9 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Air Handling Units

.2 Packaged Air Conditioning Units

.3 Exhaust Fans

.4 Boilers

.5 Heat Exchangers

.6 Fume hood controllers

.7 Neutralization tanks

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Contractor will record these demonstrations on video tape for future reference.

3.10 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 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for equipment specified in Division 21 and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.3 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for sprinkler heads and fire hose cabinet 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.

.5 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.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 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.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.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.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.

.4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect fire suppression equipment 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Refer to related sections

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions of are acceptable for installation of fire suppression systems in accordance with manufacturer's written instructions.

.1 Visually inspect site conditions where fire suppression systems are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.4 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Departmental Representative will record these demonstrations on video tape for future reference.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.6 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 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA 14-10, Standard for the Installation of Standpipe and Hose Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit complete plans to Authority of Jurisdiction for review and approval before commencement of work.

.2 Indicate grooved joint couplings and fittings on drawings.

.4 Samples:

.1 Submit the following samples:

.1 Firehose nozzles.

.2 Section of hose.

.5 Test reports:

.1 Submit certified test reports for standpipe and hose assembly from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.6 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

.7 Field Quality Control Submittals:

.1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for standpipe and hose system for incorporation into manual specified in Section 01 78 00.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in standpipe and hose assembly approved by manufacturer.

.2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Storage and Protection:

.1 Store materials indoors in dry location.

.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Relocate firehose cabinet and extend standpipe as indicated on drawings.

2.2 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: to NFPA 14.

.2 Copper tube: to NFPA 14.

.2 Fittings and joints to NFPA 14:

.1 Ferrous: screwed, welded, flanged or roll grooved.

.1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

.2 Copper tube: screwed, soldered, brazed.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, screwed ends, grooved, OS&Y gate.

.3 NPS 2 1/2 and over: cast or ductile iron, roll grooved ends, indicating butterfly valve.

.4 Check valves: spring actuated swing type, composition disc or seal.

.4 Pipe hangers:

.1 ULC listed for fire protection services.

.5 Drain valve: NPS 1, complete with hose end, cap and chain.

.6 Inspector's test connections: NPS 1 gate valve.

2.3 CABINETS

.1 To NFPA 14 and ULC listed: flush mounted, type as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with hinge same side as water supply and latching device.

.2 Cabinets to maintain fire resistive rating of construction in which they occur.

.3 Cabinet door: with 5 mm full glass panel.

.4 Large enough to accommodate angle valve, hose rack, fire hose nozzle and spanner, and NPS 2 1/2 fire department valve.

2.4 HOSE RACK

.1 ULC listed, swivel type with pins to permit hose to be hung in folds. Locking device shall prevent flow of water into hose until last fold is removed from rack. Complete with hose, nozzle and angle valve.

2.5 FIRE HOSE AND NOZZLE

.1 Hose: ULC listed, 38 mm nominal diameter, 23 m long, synthetic jacket, synthetic rubber lined.

.2 Nozzle: ULC listed, 38 mm nominal diameter, forged brass adjustable combination fog-straight stream with shut-off.

2.6 ANGLE VALVES

.1 ULC listed for fire service. NPS 1 1/2 cast or forged brass complete with hand wheel, open or drip connections, or hydrolator valve. Where water pressure exceeds 690 kPa, provide ULC listed pressure reducing device.

2.7 FIRE DEPARTMENT VALVE

.1 ULC listed, NPS 2 1/2 forged or cast brass angle valve: with thread compatible with local fire department, complete with handwheel, cap and chain. Cap to be part of ULC listing for valve.

2.8 FINISHES

.1 In finished areas, chrome plate valves, nozzles, fittings.

.2 Cabinets.

.1 Tub: prime coated.

.2 Door and frame: Painted red to match existing.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install and test to acceptance in accordance with NFPA 14.

.2 Install pipework in accordance with Section 23 05 05, supplemented as specified.

.3 Install drain pipes and valves to drain parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.

.1 Water Supply for Combined Standpipe and Sprinkler Risers:

.1 Standpipe piping may not be used to supply water for automatic fire sprinkler systems.

3.3 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.

3.4 SITE TEST

.1 General:

.1 In accordance with NFPA 14, supplemented as specified.

.2 In accordance with Section 01 91 13: General Requirements, supplemented as specified.

.2 Testing witnessed authority having jurisdiction.

.3 Disposal of water used in flushing and testing:

.1 Discuss appropriate measures with Departmental Representative.

.4 Timing:

.1 Connect fire hoses when flushing out and pressure tests have been completed.

.2 Charge system with water when there is no possibility of freeze-up.

.3 Perform tests after pressure booster pumps have been tested.

.5 Procedures:

.1 Verify that system is complete prior to start-up and testing procedures.

.2 Verify that ULC labels are visible.

.3 Fill system with water for pressure. Record water supply pressure.

.4 Pressure test piping system as required by authority having jurisdiction.

.5 Start up fire pumps and jockey pumps.

.6 Verify flow switches are operational.

.7 Verify valves in system are visible and monitored.

.8 Flushing: fill with water, let stand at operating pressure for 1 week. Drain risers separately, then drain main.

.9 Flush buried mains and lead-in connections before making connection to indoor sprinkler system.

.10 Perform flow tests, including tests of pre-action systems, as required by:

.1 Authority having jurisdiction.

.2 Applicable NFPA standards such as 13, 14, 20, 1273.

.3 Local building codes.

.6 Sundry checks:

.1 Verify that properly sized pressure restricting discs are installed where required.

.7 Identification:

.1 Verify devices are properly labelled, identifying area served, etc.

.8 Report:

.1 Refer to Section 01 91 13, reports supplemented as specified.

.2 In addition to reports required by NFPA 14, include the following:

.1 Copy of schematic and valve schedule.

.9 Posted Instructions:

.1 Prepare schematic, mount behind glare-free glass and install where directed.

.2 Prepare valve schedule, mount behind glare-free glass and install where directed.

.10 Training:

.1 Refer to Section 01 91 13: Training of O&M Personnel.

.11 Documentation:

.1 Provide written certification to Departmental Representative that system was installed, flushed and tested in accordance with Contract Documents and appropriate codes.

.2 Certificate to include:

.1 Contractors name.

.2 Contractors address.

.3 Contractors license number.

.4 List of approved materials and devices installed.

.5 Description of system test conducted.

.6 Dates of flushing and testing.

.7 Certification that connections conform to acceptable standards.

.8 Certification that system is complete and in service.

.9 Approved signage has been provided and attached as appropriate.

.10 Hose threads of system and test connections match those of responding fire department.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 National Fire Prevention Association (NFPA)

.1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.

.2 NFPA 25-2008, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

.2 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S543-09, Standard for Internal Lug Quick Connect Coupling for Fire Hose.

.2 CAN/ULC-S543-09-AM1, Amendment 1 to Standard for Internal Lug Quick Connect Coupling for Fire Hose.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Materials.

.2 Finishes.

.3 Temperature Rating.

.4 Assembly details.

.5 Accessories.

.4 Samples:

.1 Submit samples of following:

.1 Each type of sprinkler head.

.2 Graphic sample of signs.

.5 Test reports:

.1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.6 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.7 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

.8 Field Quality Control Submittals:

.1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00.

.2 Manufacturer's Catalog Data, including specific model, type, and size for:

.1 Pipe and fittings.

.2 Sprinkler heads.

.3 Mechanical couplings.

.3 Drawings:

.1 Sprinkler heads and piping system layout.

.1 Prepare 760 mm by 1050 mm detailed working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".

.2 Show data essential for proper installation of each system.

.3 Show details, plan view, elevations, and sections of systems supply and piping.

.4 Field Test Reports:

.1 Preliminary tests on piping system.

.5 Records:

.1 As-built drawings of each system.

.1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.

.2 Submit 760 mm by 1050 mm drawings with title block similar to full size contract drawings.

.3 Submit as-built drawings in AutoCAD format for recording keeping at completion of project

.6 Operation and Maintenance Manuals:

.1 Provide Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in wet sprinkler systems with documented experience.

.2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Storage and Protection:

.1 Store materials indoors in dry location.

.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Locate sprinkler heads in consistent pattern in ceiling. Avoid interference with lights, and air supply diffusers.

.2 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.3 Location of Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for ordinary hazard occupancy.

.2 Positioning of sprinkler heads to be similar to existing conditions on site, with new concealed heads located in new drywall ceiling.

.4 Water Distribution:

.1 Make distribution uniform throughout the area in which sprinkler heads will open.

2.2 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: to NFPA 13.

.2 Copper tube: to NFPA 13.

.2 Fittings and joints to NFPA 13:

.1 Ferrous: screwed, welded, flanged or roll grooved.

.1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

.2 Copper tube: screwed, soldered, brazed, grooved.

.3 Provide threaded fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.

.4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.

.5 Rubber gasketted grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.

.6 Fittings: ULC approved for use in wet pipe sprinkler systems.

.7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.

.8 Side outlet tees using rubber gasketted fittings are not permitted.

.9 Sprinkler pipe and fittings: metal.

.3 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA.

2.3 SPRINKLER HEADS

.1 General: to NFPA 13 and ULC listed for fire services.

.2 Sprinkler Head Type:

.1 Type D: concealed chrome glass bulb type with ring and cup.

.3 Provide nominal 1.2 cm orifice sprinkler heads.

.1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.

.2 Provide polished stainless steel ceiling plates or chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings.

.3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.

.4 Provide sprinkler heads as indicated on drawings.

.5 Deflector: not more than 75 mm below suspended ceilings.

.6 Ceiling plates: not more than 25 mm deep.

.7 Ceiling cups: not permitted.

2.4 PIPE SLEEVES

.1 Provide pipe sleeves where piping passes through walls.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls.

.4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

.1 Firmly pack space with mineral wool insulation.

.2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass.

.3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.

.5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:

.1 Provide hot-dip galvanized steel.

.2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

2.5 ESCUTCHEON PLATES

.1 Provide split hinge type metal plates for piping passing through walls in exposed spaces.

.2 Provide polished stainless steel plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.6 SIGNS

.1 Attach properly lettered and approved metal signs to each valve and alarm device to NFPA 13.

2.7 SPARE PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

3.4 DISINFECTION

.1 Disinfect new piping and existing piping.

.2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.

.3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.

.4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.5 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.

.2 Test, inspect, and approve piping before covering or concealing.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for equipment listed in Divisions 21 through 25, 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 Ontario, Canada.

.2 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for equipment for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems 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.

.5 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.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.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.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.

.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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not used.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Examination of Existing Conditions

.1 Visit and examine the site and note characteristics and features affecting the Work before submitting Bid.

.2 Report discrepancies in writing to Consultant prior to Bid closing.

.3 No allowances will be made for difficulties encountered or expenses incurred arising from conditions of the site or existing items that are readily visible or known to exist at the time of Bid.

.4 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

3.2 CUTTING AND PATCHING

.1 Coordinate requirements of the Work with Section 01 73 29 – Cutting and Patching.

.2 Coordinate locations of mechanical penetrations and sleeves through concrete floor structure including slabs, beams, purlins and girders; coordinate sleeving locations with other Divisions

.1 Contractor will prepare coordination drawings for each floor level of the building indicating requirements of all trades penetrating concrete floor construction.

.2 Contractor to obtain sign-off from affected mechanical subtrades having penetrations and sleeves before submitting shop drawings to Consultant for review

.3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

.5 Provide inserts, holes and sleeves, cutting and fitting required for mechanical work; relocate improperly located holes and sleeves.

.6 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.

.7 Obtain written approval from Consultant before drilling, coring, cutting or burning structural members; verify that post tensioned or pre-stressed strands are located accurately and avoid cutting or damaging these elements with an adequate margin of safety.

.8 The Contractor is responsible to patch and make good building where damaged from equipment installation, improperly located holes and similar criteria.

3.3 EXCAVATION AND BACKFILL

.1 Refer to other Divisions for requirements affecting this Work.

.2 Confirm service invert elevations and locations prior to starting work, set grades to suit inverts.

.3 Provide excavating to facilitate installation of mechanical work, including shoring, pumping, placement of 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting

3.4 EXISTING SERVICES

.1 Maintain liaison with Owner to interrupt, re-route, or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Do not shut down or make connections to any existing service without written permission from the Owner.

.3 Confirm elevations and locations of existing services prior to and during excavation.

.4 Route pipes, ducts, conduits and other services to avoid interference with existing installation.

.5 Cut back and cap existing services not being used, so that finished Work presents a neat and clean appearance.

.6 Contractor shall be responsible for any damage to existing systems, including insulation and coverings, when making connections.

.7 Existing facility to be in operation throughout the duration of Construction, with minimum length of system shut-down periods.

.8 Include overtime work for tie-in piping, ductwork, or wiring at night or on weekends.

.9 Provide Consultant with as-built drawings of site services in accordance with Section 01 78 00; dimensioned to grid lines, building exterior walls or other permanent building component.

3.5 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance; leave factory covers in place; take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.

.4 Clean piping, ducts and equipment of dirt, cuttings and other foreign substances in accordance with Section 01 74 11.

.5 Protect bearings and shafts during installation: Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling unit.

3.6 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.7 SYSTEM CLEANING

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

3.8 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.9 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Domestic, laboratory, and RO water systems.

.2 Sanitary and acid drainage piping

.3 Laboratory gas systems

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Contractor will record these demonstrations on video tape for future reference.

3.10 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 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).

.1 ANSI/ASME B16.24-2001(2006), Cast Copper Alloy Pipe Flanges and Flanged Fittings.

.2 American Society of Mechanical Engineers International (ASME)

.1 ASME B16.15-2013, Cast Copper Alloy Threaded Fittings: Classes 125 and 250.

.2 ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22-2001(R2005), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.3 ASTM International Inc. (ASTM)

.1 ASTM A307-12, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

.2 ASTM B88M-13, Standard Specification for Seamless Copper Water Tube (Metric).

.4 Canadian Standards Association (CSA International)

.1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

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

.1 Material Safety Data Sheets (MSDS).

.7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-2011, Butterfly Valves.

.2 MSS-SP-70-2011, Gray Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-2011, Gray Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.

.8 National Research Council (NRC)/Institute for Research in Construction

.1 NRCC 47668, National Plumbing Code of Canada (NPC) - 2010.

.9 Transport Canada (TC)

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management:

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 PRODUCTS

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

.2 Reverse osmosis (RO) water piping

.1 Above ground: PVC Schedule 80

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ASME B16.15.

.3 Cast copper, solder type: to ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ASME B16.22.

.5 NPS 2 and larger: roll grooved to CSA B242.

2.3 JOINTS

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: lead free.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

.7 Solvent weld PVC Schedule 80 piping for RO water system

2.4 VALVES

.1 Refer to section 23 05 23.01 for details.

.2 Provide PVC isolation valves sized to suit diameter of RO water piping as indicated on drawings and to isolate piping branches

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with NPC.

.2 Install pipe work in accordance with Section 23 05 01, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.6 Buried tubing:

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with ball valves.

3.4 PRESSURE TESTS

.1 Conform to requirements of Section 22 05 01.

.2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Federal potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.

3.6 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.8 START-UP

.1 Timing: Start up 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.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring domestic hot water storage tank up to design temperature slowly.

.4 Monitor piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB in accordance with Section 23 05 93.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize piping systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 13: Reports, using report forms as specified in Section 01 91 13: Report Forms and Schematics.

3.10 OPERATION REQUIREMENTS

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 01.

3.11 CLEANING

.1 Clean in accordance with Section 01 74 11.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 22 11 16: Domestic Water Piping

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM B32-08, Standard Specification for Solder Metal.

.2 ASTM B306-13, Standard Specification for Copper Drainage Tube (DWV).

.3 ASTM C564-12, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

.1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories. NOT ON CSA WEB SITE use another reference standard.

.2 CSA B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.

.3 CSA B125.3-12, Plumbing Fittings.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, storm, and vent: Type DWV to: ASTM B306.

.1 Fittings.

.1 Cast brass: to CSA B125.3.

.2 Wrought copper: to CSA B125.3.

.2 Solder: lead free, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary, storm, and vent minimum NPS 3, to: CSA B70.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets: to CSA B70. ASTM C564 or

.2 Stainless steel clamps.

.2 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Cold caulking compounds.

.2 Above ground sanitary, storm and vent: to CSA B70.

.1 Joints:

.1 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 In accordance with Section 22 05 00.

.2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.3 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM D2235-04(2011), Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564-12, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-Series B1800-11, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

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

Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.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 in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIAL

.1 Adhesives and sealants:

.1 Maximum VOC limit to GSES GS-36.

2.2 PIPING AND FITTINGS

.1 For buried and above ground acid waste piping to:

.1 CAN/CSA-B1800.

.2 CAN/CSA-B181.3-11 polyofin and polyvinylidene fluoride (PVDF) laboratory drainage system.

.2 Materials:

.1 Acid resistant thermoplastic PVDF, plenum rated for flame spread of 25 and smoke development of 50.

2.3 JOINTS

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 In accordance with Section 23 05 05.

.2 Install in accordance with National Plumbing and Fire Code, and local authority having jurisdiction.

3.3 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Ensure fixtures are properly anchored, connected to system and effectively vented.

.4 Affix applicable label (acid waste drainage) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)

.1 ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.2 ANSI Z21.10.1A-2006/CSA 4.1A-2006, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.3 ANSI Z21.10.1b-2006/CSA 4.1b-2006, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.4 ANSI Z21.10.3A-2007/CSA 4.3-2007, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.2 Canadian Standards Association (CSA International)

.1 CSA B51-03(R2007), Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA-C22.2 No.110-94(R2009), Construction and Test of Electric Storage Tank Water Heaters.

.3 CAN/CSA-C191-04, Performance of Electric Storage Tank Water Heaters for Household Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

.2 Electrical characteristics including voltage, phase, and current draw

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.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 20.

1.5 WARRANTY

.1 For the Work of this Section 22 30 05 - Domestic Water Heaters, 12 months warranty period prescribed in subsection GC3.13 of General Conditions is extended to number of years specified for each product.

Part 2 PRODUCTS

2.1 ELECTRIC WATER HEATER (HYDRAULICS WING)

.1 Heater to be a glass-lined commercial electric domestic water heater

.2 Heater to be constructed in accordance with ASME code, and listed with Underwriters' Laboratories

.3 All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature of 871^{o}F.

.4 Tank shall be cathodically protected with powered anodes.

.5 Entire vessel is to be enclosed in a round steel enclosure with a baked enamel finish

.6 Water heater shall have an electronic control with large LCD displaying current water heater status, provide real time element status, and sensing, low water cutoff, and economy mode operation

.7 Temperature controls include limiting switch which will require resetting manually in the event the temperature reaches 88^{o}C.

.8 Capacity: as indicated on drawings

.9 Dimensions: as indicated on drawings

2.2 INDIRECT - HOT WATER – STORAGE (WTC)

.1 Tank:

.1 Hot water generator to be constructed of a vertical storage tank

.2 Tank dimensions as indicated on drawings

.3 Interior of tank to be glass lined and fired to 871^{o}F to ensure a molecular fusing of glass and steel

.4 Tank to be furnished with a magnesium anode to provide protection against corrosion

.5 Storage tank to be completely encased in a minimum of 50mm thick, high density polyurethane foam insulation to meet the energy efficiency requirements of the latest edition of ASHRAE 90.1

.6 Tank to be furnished with a factory installed heavy steel jacket, finished with a baked acrylic enamel finish

.7 Tank to be complete with drain vale

.8 Tank to be complete with water recirculation pump with 19mm drain connection.

.2 Heater:

.1 The heater tube bundle shall be constructed and stamped according to section VIII of ASME code

.2 Tube bundles to be constructed of 19mm OD 20 gauge deoxidized drawn copper tubing

.3 Heating units shall be installed in the tank by bolted connection to the collar flange and tube bundle head

.3 Capacity: as indicated on drawings

.4 Dimensions: as indicated on drawings

2.3 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 1with hose end.

.2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.

.3 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.

.4 Thermowell filled with conductive paste for control valve temperature sensor.

.5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.

.6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

2.4 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation in concrete support pad in accordance with Section 03 30 00.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide structural steel for support, as indicated on the drawings.

.3 Provide insulation between tank and supports.

.4 Install natural gas fired domestic water heaters in accordance with CAN/CSA-B149.1.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained representative to start up and commission DHW heaters.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 The supply and installation of Plumbing Fixtures and Trim.

.2 Products Installed but not Supplied Under this Section:

.1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.

.2 Equipment installed by others.

.1 Connect with unions.

.3 Equipment not installed.

.1 Capped for future connection by others.

.3 Related Sections:

.1 Section 01 35 29.06 - Health and Safety Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.

.2 CSA-B125.3-11, Plumbing Fittings.

.3 CAN/CSA-B651-04(R2010), Accessible Design for the Built Environment.

.2 American Society for Mechanical Engineers (ASME)/Canadian Standards Association(CSA International).

.1 ASME A112.18.1-2011/CSA B125.1-11, Plumbing Supply Fittings.

.2 ASME A112.18.2-2011/CSA B125.2-11, Plumbing Waste Fittings.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.1 Indicate, for all fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

.2 Size of water and waste connections.

.2 Closeout Submittals:

.1 Submit maintenance data in accordance with Section 01 78 00.

.2 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 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.

.3 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: architectural drawings to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Refer to mechanical drawings for fixture specifications.

.8 Fixture piping:

.1 Hot and cold water supplies to each fixture:

.1 Chrome plated flexible supply pipes each with handwheel stop, reducers, escutcheon.

.2 Waste:

.1 Brass P trap with clean out on each fixture not having integral trap.

.2 Chrome plated in all exposed places.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit and safety controls.

3.3 TESTING

.1 Verification correct operation of fixtures in accordance with the requirements of Sections 01 91 13.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 22 11 16: Domestic Water Piping

.3 Section 22 13 17: Drainage Waste and Vent Piping – Cast Iron and Copper

.4 Section 22 13 18: Drainage Waste and Vent Piping – Plastic

1.2 REFERENCES

.1 ASTM International

.1 ASTM A126-04(2014), 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 American Water Works Association (AWWA)

.1 ANSI/AWWA C700-09, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.

.2 ANSI/AWWA C701-12, Standard for Cold Water Meters-Turbine Type for Customer Service.

.3 ANSI/AWWA C702-10, Standard for Cold Water Meters-Compound Type.

.3 CSA International

.1 CSA-B64 Series-11, Backflow Preventers and Vacuum Breakers.

.2 CSA B79-08, Commercial and Residential Drains and Cleanouts.

.3 CAN/CSA-B356-10, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Plumbing and Drainage Institute (PDI)

.1 PDI-G101-R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201-R2010, Water Hammer Arresters Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products 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. Indicate VOC's.

.3 Shop Drawings:

.1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details and accessories.

.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 Manufacturers' Field Reports: manufacturers' field reports specified.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect plumbing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to CSA B79.

.2 Refer to plumbing schedules.

2.2 ROOF DRAINS

.1 Type 1: standard roof drain with cast iron body with aluminum 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, polished nickel bronze round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: nickel bronze round gasket, vandal-proof screws.

.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.4 WATER HAMMER ARRESTORS

.1 Copper construction, piston type.

2.5 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application as indicated, reduced pressure principle type.

2.6 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

2.7 PRESSURE REGULATORS

.1 Capacity:

.1 Inlet pressure: 1034 kPa.

.2 Outlet pressure: 413 kPa.

.2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62.

.3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.

.4 Semi-steel spring chambers with bronze trim.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

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

2.9 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.

2.10 TRAP SEAL PRIMERS

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

2.11 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.

2.12 IN-LINE CIRCULATORS

.1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: cast bronze lead free.

.3 Shaft: 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 TEFC, sleeve bearing.

.7 Capacity: as indicated.

.8 Design pressure: as indicated.

2.13 ACID NEUTRALIZER

.1 Buried acid neutralization tank complete with sediment interceptor and PH monitoring system.

.2 Neutralization tank

.1 Sump: Rotationally molded form extra high stress, crack resistant virgin linear, low density polyethylene

.2 Tops and Inspection Ports: minimum 13mm thick extruded high density, stress relieved, fabrication grade polyethylene sheet stock.

.1 Fittings: minimum, series 60 high density polyethylene pipe.

.2 Fastening Hardware: Stainless steel.

.3 Gaskets: Neoprene.

.4 Provide a full charge of limestone at time of building hand over.

.5 Provide cover and access hatch flushed with finish floor. Cover to be steel primed coated. Provide inspection port.

.6 Unit to be sized for a capacity of 100L empty, and 46L charged, 75mm inlet and 75mm outlet.

.3 Sediment Interceptor

.1 Unit construction to match neutralization tank.

.2 Outlet of interceptor to mate and match with inlet of neutralizing tank.

.3 Provide cover and access hatch flushed with finish floor. Cover to be steel primed coated.

.4 PH monitoring System

.1 Digital pH monitoring and alarm panel.

.2 Microprocessor based meter, fully programmable complete with LCD display and 4-20mA output to BAS, complete with general alarm.

2.14 SOLIDS INTERCEPTOR

.1 Floor mounted epoxy coated steel solids interceptor, complete with gasketed epoxy steel skid-proof cover secured with hex head centre bolts, removable sediment basket, and no hub connections

.2 Interceptor body to be steel

.3 Size for flow rate of 1.58 L/s (25 GPM)

2.15 PRE-PACKAGED DUPLEX PUMP STATION

.1 Provide duplex pump set, complete with high density polyethylene structural foam basin.

.2 Basin size to be 610 mm diameter and 915 mm in height. Basin to be one seamless piece.

.3 Basin to be complete with necessary sealing hardware and flanges

.4 Duplex cover to be provide with two access plates

.5 Cover to be water and gas tight.

.6 Pump station to be complete with floats for on/off control.

.7 Duplex pump station to be supplied with control panel.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.

.1 Visually inspect site conditions in area where equipment is to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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 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 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 WATER HAMMER ARRESTORS

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

3.6 BACK FLOW PREVENTERS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.1 Drains.

.2 Backwater Valves.

.3 Water Make-up Assembly.

.2 Pipe discharge to terminate over nearest drain or service sink.

3.7 HOSE BIBBS AND SEDIMENT FAUCETS

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

3.8 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Departmental Representative.

.3 Install soft copper tubing to floor drain.

3.9 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.10 WATER MAKE-UP ASSEMBLY

.1 Install on valved bypass.

.2 Pipe discharge from relief valve to nearest floor drain.

3.11 ACID NEUTRALIZER

3.12 BURIED ACID NEUTRALIZATION

.1 Install in accordance with NBC and National Plumbing Code.

.2 Provide acid resistant vent directly through roof.

3.13 START-UP

.1 General:

.1 In accordance with Section 01 91 13: 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.

3.14 TESTING AND ADJUSTING

.1 General:

.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13: 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 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removability of strainer.

.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.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 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.11 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.12 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.13 Acid neutralizer:

.1 Activate, using manufacturer's recommended procedures and materials.

.14 Hose bibbs, sediment faucets:

.1 Verify that flow and pressure meet design criteria.

.2 Check for leaks, replace compression washer if required.

.15 Hydronic system water Make-up Assembly:

.1 Verify flow, pressure, and connection.

.16 Pre-packaged Pump Station

.1 Verify flow, pressure, and connection

3.15 CLOSEOUT ACTIVITIES

.1 Commissioning Reports: in accordance with Section 01 91 13: reports, supplemented as specified.

.2 Training: provide training in accordance with Section 01 91 13: Training of O&M Personnel, supplemented as specified.

3.16 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

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

3.17 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 SUMMARY

.1 This Section includes general provisions applicable to all work relating to the engineering, fabrication, erection, and commissioning of a complete laboratory gas system.

.2 This Section includes descriptions for supply and installation of the following laboratory gas systems:

- .1 Laboratory Oxygen System
- .2 Laboratory Nitrogen System
- .3 Laboratory Helium System
- .4 Laboratory Hydrogen System
- .5 Laboratory Vacuum System
- .6 Laboratory Compressed Air System
- .7 Systems descriptions include, but are not limited to, the following components:
  - .1 Pipe, fittings, valves, valve boxes, alarms and sensing devices.
  - .2 Installation of service piping and connection to owner supplied gas cylinders.

1.2 RELATED REQUIREMENTS

.1 Section 21 05 01 – Common Work Results - Mechanical.

.2 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

- .1 ANSI/AWS A5.8/A5.8M-2004, Specification for Filler Metals for Brazing and Braze Welding

.2 American Society of Mechanical Engineers (ASME):

- .1 ASME Pressure Vessels And Piping Codes And Standards, 2000
- .2 ASME B16.18-2001(R2005), Cast Copper Alloy Solder Joint Pressure Fittings
- .3 ASME B16.22-2001(R2005), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.3 American Society for Testing and Materials (ASTM):

- .1 ASTM A167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet, and Strip
- .2 ASTM A269-13, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- .3 ASTM A403/A403M-10a, Standard Specification for Wrought Austentic Stainless Steel Piping Fittings
- .4 ASTM B32-08, Standard Specification for Solder Metal

.5 ASTM D1785-06, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

.6 ASTM D2466-06, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings, Schedule 40

.7 ASTM D2564-04(2009)e1, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1.4 SUBMITTALS

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

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Submit shop drawings indicating general assembly of components, mounting and installation details, and general layout of control and alarm panels.

.2 Submit product data, manufacturers literature and illustrations indicating size, dimensions and configuration of all components forming a part of the gas system including, but not limited to, the following:

.1 Valves

.3 Information Submittals: Provide the following submittals when requested by the Consultant:

.1 Submit certification indicating compliance to codes and standards referenced in this Section and required by the authorities having jurisdiction.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Submit required information in accordance with Section 01 77 00 – Closeout Procedures.

.1 Equipment list identifying components used in each system including installation instructions, operating instructions, and assembly views.

.2 Equipment manufacturers names and addresses.

.3 Equipment maintenance data including maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone numbers.

.4 Detailed drawings of equipment and components.

.5 Manufacturers service manuals for equipment.

Valve schedule listing valves in the system with location.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Conform with applicable codes for supply and installation of laboratory gas systems.

.2 Perform work in accordance with NFPA 45, other referenced codes and standards, and requirements of this Section; maintain one copy of each document referenced in this section on site.

.3 Qualifications: Provide proof of qualifications when requested by Departmental Representative:

.1 Verify installer is a company specializing in performing the work of this Section having a minimum of three (3) years documented experience, and as follows:

.1 Installing personnel to hold current certification or license indicating that they are skilled in the installation of laboratory gas systems.

.2 Provide evidence of certification for the Consultant prior to any work being performed on the laboratory gas systems.

.4 Provide materials that are complete in every respect and ready to be in operation at completion of the work and as follows:

.1 New materials and of the best grade and quality obtainable.

.2 Materials to comply with relevant standards and codes listed in this section and as required by the Authorities Having Jurisdiction.

.3 Equipment must be CSA Approved and bear a CSA Label indicating compliance with specified standards.

.5 Specific reference to a phrase or component within a particular Code or Standard in this specification is made to emphasize and clarify the intent of the Section; compliance with these individual points does not constitute or relieve installer or testing agency from complying with the remaining applicable sections of the reference Codes and Standards.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 This section includes requirements for the supply, installation and testing of equipment, devices, valves and piping required for a complete oxygen, nitrogen, helium, hydrogen, and vacuum delivery system meeting applicable laboratory gas piping systems codes and standards as listed in this Section.

.2 Components forming a part of the laboratory gas system include, but are not limited to, the following:

.1 Pipe and pipe fittings.

.2 Valves.

2.2 GAS AND COMPRESSED AIR PIPING, FITTINGS, AND JOINTS

.1 Piping: Following applies to distribution system piping:

.1 Tube: ASTM B819, Type K or L:

.1 Use Type K for systems having an operating pressure of 1380 kPa or greater.

.2 Concealed Piping: Soft Temper.

.3 Exposed Piping: Hard Temper.

.2 Service Rating: Suitable for oxygen service, permanently labelled and delivered plugged, capped or otherwise sealed to prevent contamination of internal surfaces.

.3 Plugs, caps or other seals to remain in place until final assembly.

.4 Copper Tubing: Type "K" seamless copper cleaned and degreased in accordance with ASTM B819.

.5 Protective Caps: Cap open ends of piping to prevent contamination of system until fixtures or fittings are attached.

.2 Fittings: ASME B16.22, cleaned for oxygen service:

.1 Deliver fixtures plugged, capped, bagged or otherwise sealed to prevent contamination of internal surfaces.

.2 Keep plugs, caps, bags or other seals in place until final assembly.

.3 Joints: Brazed using an AWS A5.8 BCuP Series filler metal and flux recommended for gas piping systems for interior installations.

2.3 VACUUM PIPING, FITTINGS AND JOINTS

.1 Tube:

.1 Exposed Locations: Hard Temper ASTM B88 Type L or Type M, ASTM B280 Type ACR, or ASTM B819 Type L.

.2 Concealed Underground Locations: Soft Temper ASTM B 88 Type L, or ASTM B280 Type ACR, soft temper for concealed locations.

.2 Fittings: ASME B16.18, ASME B16.22.

.3 Joints: Brazed using an AWS A5.8 BCuP Series filler metal and flux recommended for gas piping systems for interior installations.

2.4 SHUT-OFF VALVES

.1 Provide lever handle valves, double seal type ball valves having a minimum pressure rating of 2070 kPa. Fabricate valve of forged bronze and designed in such a manner that it can be “swung out” during installation, so as to prevent damage, due to heat transfer during brazing operations.

.2 Level handle to require a quarter of a turn from the fully open position to a fully closed position. Valve seals must be of a BUNA-N compound and seal on a chromium plated bronze ball. Valve stem to incorporate a dual "O" ring seal for blow out proof operation.

.3 Type "K" washed and degreased copper tubing stubs extend from both the inlet and the outlet sides of the valve to facilitate installation.

.4 Each bare valve in areas accessible only to authorized personnel to state the specific gas or vacuum being controlled by that valve; and have the lever handle removed, with the valve in the open position.

.5 Provide washed and degreased valve for oxygen usage and stub end extensions capped at both ends.

.6 Contractor to exercise considerable care in storing to prevent contamination of valves prior to installation. All equipment and valves to be properly protected on site.

Part 3 Execution

3.1 CLEANING

.1 Material Cleaning Requirements:

.1 Fittings, tube, valves, and piping system components cleaned for oxygen service in accordance with CGA Pamphlet G-4.1. Cleaning performed by the manufacturer or a facility equipped to clean, rinse, and purge the material in accordance with CGA Pamphlet G-4.1.

.2 Immediately before final assembly, fittings, tube, valves, and piping system components visually examined internally for contamination. Material that has become contaminated to not be installed.

.3 On-site cleaning of the interior surfaces of fittings, tube, valves, and piping system components limited to recleaning surfaces in the immediate vicinity of the joints that have become contaminated prior to brazing. These surfaces must be cleaned by washing in a clean, hot water/alkaline solution such as sodium carbonate or trisodium phosphate (1 lb. to 3 gal. of potable water). Scrub thoroughly the interior surfaces and rinse with clean, hot, potable water.

3.2 LABORATORY GAS INSTALLATION REQUIREMENTS

.1 Brazers qualified in accordance with the requirements of NFPA 45.

.2 Brazing flux will not be used in joints between copper tube and ASME B16.22 fittings.

.3 In applications where copper tube must be joined to brass or bronze system components brazing flux will be applied sparingly to the exterior surface of the tube. Brazing flux will not be applied to the interior surfaces of the fitting.

.4 During installation care will be taken to avoid contamination of interior “cleaned for oxygen service” surfaces of piping system components. Joints brazed within one hour of being cleaned.

.5 While being brazed, joints continuously purged with a positive flow of oil-free dry nitrogen to prevent the formation of copper oxide on the interior surface of the joint. Maintain the flow of purge gas until the joint is cool to the touch.

.6 During and after installation, openings in the piping system kept capped, plugged or sealed to avoid unnecessary loss of purge gas while brazing and to prevent contamination of the system. During brazing, a discharge opening provided on the opposite side of the joint from where the purge gas is being introduced. After brazing, this discharge opening capped, plugged or sealed to prevent contamination of the system.

.7 Brazed joints allowed to cool to the touch naturally and not be shock cooled. After cooling, all joints cleaned with water and a stainless steel wire brush to remove any residue and permit clear visual inspection of the joint. Where flux has been permitted, use hot water.

.8 Site fabricated, mechanically formed tees/outlets and couplings will not be used.

3.3 VACUUM INSTALLATION REQUIREMENTS

.1 The outside of all joints be cleaned by washing with hot water after assembly and cooling.

.2 After installation of the piping, but before attachment of the vacuum line to the vacuum pump(s) and receiver(s), and before installation of the vacuum alarm switches, station inlets, and gauges, blow clear the line by means of oil-free, dry nitrogen or air.

.3 Before erection, all pipe, tubing, valves and fittings (except those supplied expressly cleaned for oxygen and nitrous oxide services by manufacturer) be thoroughly cleansed of all grease, oil, or other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in proportions of 2.2 kg to 11.25 L of water.

.4 Scrubbing and continuous agitation of the parts employed where necessary to remove all deposits and ensure complete cleansing. After washing, all materials be rinsed thoroughly in clean, hot water and blown clean with nitrogen.

.5 After cleansing, great care must be exercised in the storage and handling of all materials and in condition of tools used in cutting and reaming to prevent oil or grease being introduced into the tubing. Where such contamination is known to have occurred, the materials must be rewashed and then rinsed.

3.4 PIPING FABRICATION

.1 All joints in pipe and tubing, except those at equipment requiring screwed connections, be made with brazed-joint type wrought fittings. Suitable adapters be employed for installation of equipment provided with threaded connections, all threaded connections must be tinned.

.2 All brazed connections be made with type of brazing alloy as specified above in "PIPE, FITTINGS, AND JOINTS". The joining processes be those recommended by the manufacturer of pipe, tubing, and fittings. Avoid leaving excess flux inside of the pipe and fittings.

.3 Screwed Connections: Telfon Tape applied to the external threads only, leaving first thread clean if possible.

.4 Bends: All changes in direction requiring turns at offsets of radius less than five times the pipe or tubing outside diameter be made with braze-type wrought fittings, or by pipe or tubing shaped by bending tools. All bends be free of any appreciable flattening, buckling or thinning of the tube wall at any point.

.5 Piping systems for gases not be used as a grounding electrode.

.6 All pipe and tubing cut accurately to measurements obtained at the site of the system and installed without springing or forcing.

.7 Gas piping not be supported by other piping, nor laboratory gas piping be used to support other pipe or conduit. Provide support with pipe hangers suitable for the size of pipe and of proper strength and quality, at proper intervals, so that piping cannot be moved accidentally from the installed position as follows:

6.3 mm pipe or tubing	1200 mm
9.5 mm pipe or tubing	1200 mm
15 mm pipe or tubing	1800 mm
20 mm to 25 mm pipe or tubing	2400 mm
30 mm or larger (horizontal)	3000 mm
30 mm or larger (vertical)	every floor level

.8 All copper pipe, tubing, valves, and fittings be precleaned and prepared for oxygen service in accordance with NFPA 45 except those supplied especially prepared for oxygen service by the manufacturer and received sealed on the job.

.9 During the brazing of pipe connections, the interior of the pipe purged continuously with nitrogen. The outside of the tube and fittings cleaned by washing with hot water after assembly.

.10 Threaded joints in piping systems be tinned or made up with polytetrafluorethylene (such as Telfon) tape or other thread sealants suitable for oxygen service. Sealants applied to the male threads only.

.11 Buried piping adequately protected against frost, corrosion, and physical damage. Ducts or casings used wherever buried piping traverses a roadway, driveway, parking lot, or other area subject to surface loads.

.12 Piping exposed to physical damage adequately protected. Protect pipe or tubing in corridors or other locations where exposed to damage from moving equipment.

.13 Supply and install any additional isolation valves required to obtain certification by the Testing Agency, and to meet the requirements of the codes and standards referenced.

3.5 IDENTIFICATION OF PIPING

.1 Label all laboratory gas piping to indicate its gas content. All laboratory gas pipelines have a permanent pipeline identifier and label applied at 6.0 m intervals, before and after barriers, and behind access doors and inlet and outlet points.

3.6 PIPING SYSTEMS TESTING

.1 After installation of the piping and valves, but before installation of the service outlets, alarm actuating switches and gauges, blow the line clear by means of nitrogen.

.2 After installation of the rough-in portion of service outlets and area line pressure alarms, but before closing of the walls, each section of piping system subjected to a test pressure of one and one-half (1½) times the maximum working pressure, but not less than 1030 kPa with nitrogen. This test pressure maintained until each joint has been examined for leakage by means of soapy water or other effective means of leak detection safe for use with oxygen.

.3 Repair all leaks and the section retested.

.4 After completing the testing of each individual piping system, all of the laboratory gas systems subjected to a 24-hour standing pressure test at one and one-half (1½) times the maximum working pressure, but not less than 1030 kPa. The test gas will be nitrogen. The main line shut-off valve closed during the test.

.5 Leaks, if any, will be located, repaired, and the system retested.

.6 Provide purging valves for this purpose.

.7 Use temporary cylinders for this purpose.

.8 Perform pressure test and cross connection test as per code requirements.

3.7 RECORD DRAWINGS

.1 The record drawings presented to the Owner as a set of permanent reproducible drawings marked "Record for Laboratory Gas Piping Systems Only" and be part of the permanent records of the facility of which the piping system is a part. Record drawings produced by this contractor to the same drafting standards as the contract drawings.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities.

1.2 USE OF SYSTEMS

.1 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

- .1 Active portion of system is complete, pressure tested, cleaned, flushed out.
- .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
- .3 Areas of the building under construction have been closed in, and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .4 There is no possibility of damage from any cause.
- .5 Supply ventilation systems are protected by 60% filters, which shall be inspected daily, changed every week, or more frequently as required.
- .6 Return systems have approved filters over all openings, inlets, outlets.
- .7 All systems will be:
  - .1 operated as per manufacturer's recommendations or instructions.
  - .2 operated by Contractor.
  - .3 monitored continuously by Contractor.
- .8 Warranties and guarantees are not thereby relaxed.
- .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
- .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.

.2 Filters referred to herein are over and above those specified elsewhere in this specification.

.3 Exhaust systems are not included in any approvals for temporary heating ventilation.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.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, paddling, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 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.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 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. 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.

3.5 AIR VENTS

.1 Install automatic air vents 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.

3.6 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.

3.7 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, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless otherwise 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 otherwise specified.

.7 Install butterfly valves on chilled water and related condenser water systems only.

.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.

.9 Install ball valves for glycol service.

.10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and 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: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00.

.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.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system in accordance with Section 23 08 02.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 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.

3.12 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.

.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.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval 7 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

3.14 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI/ASHRAE/IES).

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

1.2 SECTIONS INCLUDES

.1 Electrical work to conform to Electrical Divisions including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 MOTORS

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

.2 Performance Requirements: Provide only inverter grade motors.

.3 Variable Speed Drives: Design motors for operation with Variable Frequency Drives as noted on the Motor Schedule.

.4 Supply mechanical equipment complete with electrical motors.

.1 Provide a complete listing of motors required on the project within twenty (20) days of contract award; list kW, Voltage, Phasing, efficiency, and other pertinent information for review.

.2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI.

.3 Motors shall conform to EEMAC Standard MG1, applicable IEEE Standards, and applicable CSA Standards unless otherwise noted. All motors to be high efficiency in accordance ASHRAE 90.1.

.5 Electrical Requirements:

.1 Voltage and Frequency:

.1 Under .373 kW, provide single phase 120V motors.

.2 .373kW and larger, provide 3-phase, 60Hz power supply at 600 Volts or 208Volts.

.3 Design and manufacture motors to operate with $\pm$10% voltage and $\pm$5% frequency variations of the nameplate ratings.

.4 Do not exceed a combined voltage and frequency variation of $\pm$10%.

.2 Operating Characteristics:

.1 Torque: Motors must meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standard for Design B for the ratings specified.

.2 Current: Locked rotor (starting) currents are not to exceed NEMA Design B maximum values for the specified rating. Motors are capable of a 20 second stall at six times full load current without injurious heating to the motor components.

.3 Efficiency: Premium Efficient design Motors will have a minimum and nominal full load efficiency that will meet or exceed the values listed in NEMA MG-1, 12.55 Table 12-6B when tested in accordance with NEMA test standard MG1-12.54.1, IEEE Test Procedure 112, Method B using accuracy improvement by segregated loss determination including stray load loss measurements. The minimum efficiency is guaranteed.

.4 Power Factor: The power factor of 3600 and 1800 rpm, 3 through 186.5 kW 250 HP ratings at full load, at full voltage must be a minimum of 85%. Six pole ratings will be excluded from this requirement.

.3 Service Factor and Ambient:

.1 Standard motors will be rated for a 1.15 service factor in a 400°C ambient.

.4 Insulation:

.1 Install standard motors with a full Class F non-hygroscopic insulation system.

.2 Dip and bake standard motors in polyester varnish to consolidate the winding.

.6 Mechanical Construction:

.1 Frame Size:

.1 Conform the horsepower/frame relationship to the latest NEMA standard for T-frame motors.

.2 Motors covered by this specification will be 143T-449T frame sizes.

.2 Motor Type:

.1 Totally Enclosed Fan Cooled (TEFC):

.1 Design motor to prevent free exchange of air between inside and outside of motor housing.

.2 Provide integral fan to direct cooling air over exterior surface of frame; fan constructed from one piece corrosion-resistant material.

.3 Construct fan covers from pressed steel for frames 140T-400T and of cast iron for 440T frames.

.4 Construct motor frame and end brackets from cast iron construction; include stainless steel nameplate.

.5 Provide two (2) drains at lowest point in frame.

.3 Bearings:

.1 All motors must have anti-friction bearings, sized for L-10 life of at least 50,000 hours under minimum V belt heave sizes for maximum loading conditions, refer to NEMA MG-1, 14.41 Table 14-1, or 150,000 hours L-10 life for a direct connected load.

.2 Bearings must be double-shielded, vacuum degassed steel ball bearings selected for electric motor service.

.3 Re-grease bearing housings with provision for purging old grease.

.4 Lubricate bearings with a premium moisture resistant grease of a temperature range of -290°C to +1490°C.

.5 Cast iron inner bearing caps.

.6 Zinc cadmium plate all fasteners and motor hardware.

.7 Use cast iron conduit box, diagonally split and rotatable in 90° increments:

.1 Use four (4) hex head bolts to secure conduit box to frame.

.2 Use four (4) hex head bolts for the conduit box cover.

.8 Zinc cadmium plate external hardware to resist corrosion.

.9 External full gloss epoxy enamel paint withstands industrial environments.

.10 Choose stainless steel and stamped nameplates in accordance with NEMA MG-1, 10.40. Nameplate information must include the nominal efficiency value in accordance with standard NEMA MG-1, 12.54.2.

.7 Motor Tests and Inspections:

.1 Production Tests: Each motor shall receive a routine commercial testing in accordance with NEMA MG-1, 12. Prototype test reports shall be for each rating.

.2 Sound Level: The noise level of each motor shall comply with NEMA MG-1, 12.49.

.3 Vibration Level: The vibration level of each motor shall not exceed those values listed in NEMA MG-1, 12.05.

2.2 MOTOR STARTER AND ACCESSORIES:

.1 NEMA type, motor starters in accordance with the following specification and the motor starter schedule(s), unless otherwise noted. All loose motor starters and accessories shall be supplied and installed by the Mechanical trade.

.2 All starter locations shall be coordinated with electrical discipline on site. It is mechanical contractor’s responsibility to coordinate starter locations with electrical on site prior to commencement of electrical rough-ins.

.3 Unless otherwise noted, starters for single phase motors to be 120 volt, thermal overload protected manual starting switches with a neon pilot light, a surface or flush mounting NEMA enclosure to suit the application. Where an automatic operation is required, the enclosure shall also include a "Hand-Off-Auto" selector switch c/w minimum 2 NO and 2 NC contacts in an enclosure to match the starter enclosure. The starter enclosure shall be equipped with all required power supply, control transformer and fuses etc. to make it a complete and operational starter.

.4 Unless otherwise noted, starters for 3 phase motors less than 50Hp (37.3 kw) to be full voltage, non-reversing magnetic starters for across-the-line service. Full protection of each phase to be included in the starters by means of one (1) overload relay per phase per starter. Starters to be equipped with "Hand-Off-Auto" switches, pilot lights, control transformers, auxiliary contacts (minimum 2NO and 2 NC), and other accessories as per the starter schedule(s).

.5 Unless otherwise noted, starters for 3 phase motors 50 Hp (37.3 kW) up to 150 Hp (112 kW), to be reduced voltage, non-reversing, auto-transformer type starters. Full protection of each phase to be included in the starters by means of one (1) overload relay per phase per starter. Starters to be equipped with "Hand-Off-Auto" switches, pilot lights, control transformers, auxiliary contacts (minimum 2NO and 2 NC), and other accessories as per the starter schedule(s).

.6 Unless otherwise noted, starters for 3-phase motors 150 HP (112 kW) or larger, shall be reduced voltage, non-reversing, closed transition "wye-delta" starters. Full protection of each phase shall be included in the starters by means of one (1) overload relay per phase per starter. Starters shall be equipped with "Hand-Off-Auto" switches, pilot lights, control transformers, auxiliary contacts (minimum 2NO and 2 NC) and other accessories as per the starter schedule(s).

.7 Enclosures for starters located in sprinklered areas to be NEMA 3, enclosure for starters located outdoors shall be NEMA 4X, other loose starter enclosures to be NEMA 1 unless otherwise noted.

.8 The motor starter(s) for 2-speed fan(s) to be 2-speed type suitable for use with a two-speed double winding motor and complete with a forty-five (45) second time delay to allow the fan to coast down to low speed before it is operated at low speed.

.9 Identification nameplates to be engraved black-white-black lamacoid, suitably sized, complete with bevelled edges and stainless steel securing screws. Engraving must be approved by the Consultant.

.10 Each starter supplied must be capable of starting the particular motor under the imposed load.

2.3 SOURCE QUALITY CONTROL

.1 Tests and Inspections:

.1 Production Tests: Each motor will receive a routine commercial testing in accordance with NEMA MG-1, 12. Produce prototype test reports for each rating.

.2 Sound Level: The noise level of each motor must comply with NEMA MG-1, 12.49.

.3 Vibration Level: The vibration level of each motor must not exceed those values listed in NEMA MG-1, 12.05.

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 specified.

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

.4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave to be determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00.

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.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

Part 3 EXECUTION

3.1 INSTALLATION

.1 prior to installation.

.2 Mechanical subtrade is responsible for installing motors for mechanical equipment; deciding location of motors, conduit and connection points shown for equipment supplied by mechanical and as indicated on Electrical Drawings for estimating purposes only.

.3 Division 26 will provide line voltage connections for all mechanical equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A105/A105M-10a, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.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.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and operation data in accordance with Section 01 78 00.

.1 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SLIP TYPE EXPANSION JOINTS

.1 Application: for axial pipe movement, as indicated.

.2 Repacking: under full line pressure.

.3 Body and packing housings: Class 150, 1MPa carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe with raised face weld neck flanges to match pipe.

.4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, hard chrome plated.

.5 Anchor base: construction steel, welded to body.

.6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.

.7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.

.8 Packing rings: 6 minimum, PTFE impregnated non-asbestos.

.9 Thermal plastic packing: PTFE impregnated non-asbestos slug supplied loose.

.10 Lubricating fittings: pet cocks with grease nipple.

.11 Plunger body and plunger:

.1 Plunger body: heavy wall carbon steel welded to body.

.2 Plunger: carbon steel with hex head for use with socket wrench.

.12 Lubricant: to manufacturer's recommendations.

.13 Lubricant gun: complete with hose assembly.

.14 Drip connection: 20 MPa forged steel to ASTM A105/A105M. Include half coupling with drain plug.

2.2 BELLOWS TYPE EXPANSION JOINTS

.1 For axial, lateral or angular movements, as indicated.

.2 Maximum operating pressure: as indicated.

.3 Maximum operating temperature: as indicated.

.4 Type A: controlled flexing, factory tested to 1 ½ times maximum working pressure. Provide test certificates.

.5 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1 ½ times maximum working pressure. Provide test certificates.

.6 Bellows:

.1 Multiple bellows, hydraulically formed, single ply, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.

.7 Reinforcing or control rings:

.1 2 piece nickel iron.

.8 Ends:

.1 For butt welding or flanges to match pipe.

.9 Liner:

.1 Austenitic stainless steel in direction of flow.

.10 Shroud:

.1 Carbon steel, painted.

2.3 FLEXIBLE CONNECTION

.1 Application: to suit motion as indicated.

.2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.

.3 Inner hose: stainless steel corrugated.

.4 Braided wire mesh stainless steel outer jacket.

.5 Diameter and type of end connection: as indicated.

.6 Operating conditions:

.1 Working pressure: 1034 kPa.

.2 Working temperature: as indicated.

.3 To match system requirements.

2.4 ANCHORS AND GUIDES

.1 Anchors:

.1 Provide as indicated.

.2 Concrete: to Section 03 30 00.

.3 Reinforcement: to Section 03 20 00.

.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 APPLICATION

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

3.2 INSTALLATION

.1 Install expansion joints with cold setting, as indicated on drawings. 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.

.4 Do welding in accordance with section 23 05 17.

3.3 PIPE CLEANING AND START-UP

.1 In accordance with Section 23 08 02.

3.4 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

.1 ASME B31.1-2010, Power Piping.

.2 ANSI/ASME B31.3-2006, Process Piping.

.3 ASME Boiler and Pressure Vessel Code BPVC-2010:

.1 BPVC 2010 Section I: Power Boilers.

.2 BPVC 2010 Section V: Nondestructive Examination.

.3 BPVC 2010 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.

.2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.

.3 AWS W1-2000, Welding Inspection Handbook.

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1-2008, Certification of Welding Inspection Organizations.

.6 CSA W178.2-2008, Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to Departmental Representative.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.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 paddling and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Mechanical Divisions applicable requirements of authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 10 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and full gamma ray radiographic (hereinafter referred to as "radiography") tests.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic tests].

.5 Full radiographic tests for steam piping systems.

.1 Spot radiography:

.1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.

.2 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to Departmental Representative. Replace film if rejected because of poor quality.

.3 Interpretation of radiographic films:

.1 By qualified radiographer.

.4 Failure of radiographic tests:

.1 Extend tests to welds by welder responsible when those welds fails tests.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 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 Green Seal Environmental Standards (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.2 GS-36-11, Standard for Commercial Adhesives.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Shop drawings to indicate:

.1 Units of measurement

.2 Dimensions

.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.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 thermometers and pressure gauges indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect thermometers and pressure gauges 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4.

.1 Resistance to shock and vibration.

2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter mercury-free, liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass.

2.5 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

.5 Bronze stop cock.

.6 Oil filled for high vibration applications.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for installation in accordance with manufacturer's written instructions.

- .1 Visually inspect area where thermometers and gauges are to be installed.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

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 Heat exchangers.
- .2 Water heating and cooling coils.
- .3 Water boilers.
- .4 Chillers.
- .5 DHW tanks.

.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 PRV's.
- .3 Upstream and downstream of control valves.
- .4 Inlet and outlet of coils.
- .5 Inlet and outlet of liquid side of heat exchangers.
- .6 Outlet of boilers.
- .7 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 lamicoid nameplates in accordance with Section 23 05 53.01, identifying medium.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).

.2 ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International

.1 ASTM A276-10, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283/B283M-11a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-11, Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

.3 MSS SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.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.

.3 Shop Drawings:

.1 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 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..

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Provide valves in accordance with the valve schedule that forms part of this Section.

.2 Use one manufacturer only for all valves of the same type.

.3 Equip valves with renewable seats suitable for the service intended and to provide positive shutoff.

.4 Provide composition discs on globe and check valves that are suitable for temperature and fluid or gas encountered.

.5 Comply with ANSI B16.18 for solder joint ends.

.6 Comply with ANSI/ASME B1.20.1 for threaded ends.

.7 Comply with ANSI/AWWA C606 and CAN/CSA B242 for grooved ends.

.8 Comply with ANSI/ASME B16.1 for cast iron flanges with face-to-face distance to ANSI/ASME B16.10.

.9 Comply with ASTM A126 Cl.B for cast iron valves; bronze valves to ASTM B61 and ASTM B62 as noted.

.10 Threaded Valve Stem Materials: Naval brass to ASTM B21/B21M; copper silicone alloys to ASTM B98/B98M; or phosphor bronze to ASTM B139/B139M.

2.2 VALVE APPLICATION SCHEDULE

HEATING SYSTEMS (Heating Water, Condenser Water and Glycol)							
STYLE		0 - 50 mm	55 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	1.5	1.5	1.5	1.5	1.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
BUTTER-FLY	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	7.1	7.1	7.1	7.1	7.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
BALANC-ING	Connection	--	Grooved / Flanged	Grooved / Flanged	Grooved / Flanged	Grooved / Flanged	Grooved / Flanged
	Valve Item Number	--	13.4 / 13.3	13.4 / 13.3	13.4 / 13.3	13.4 / 13.3	13.4 / 13.3
	Function	--	Circuit balancing	Circuit balancing	Circuit balancing	Circuit balancing	Circuit balancing
GLOBE	Connection	--	Flanged	--	--	--	--
	Valve Item Number	--	2.6	--	--	--	--
	Function	--	Isolation/ Throttling	--	--	--	--
GATE	Connection	--	--	--	--	--	--
	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
GLOBE	Connection	--	--	--	--	--	--
	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
CHECK	Connection	--	Flanged/Grooved	Flanged/Grooved	Flanged	Flanged	Flanged
	Valve Item Number	--	3.4 / 3.7	3.4 / 3.7	3.4	3.4	3.4
	Function	--	Check	Check	Check	Check	Check
CHECK	Connection	--	--	--	--	--	--
	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
SPRING CHECK	Connection	--	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved
	Valve Item Number	--	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4 / 4.5
	Function	--	Check Condenser Water Pumps	Check Condenser Water Pumps	Check Condenser Water Pumps	Check Condenser Water Pumps	Check Condenser Water Pumps
PLUG	Connection	--	Flanged/Grooved	Flanged/Grooved	Flanged/Grooved	Flanged/Grooved	Flanged
	Valve Item Number	--	5.2 / 5.7	5.3 / 5.7	5.4 / 5.7	5.4 / 5.7	5.4
	Function	--	Balancing	Balancing	Balancing	Balancing	Balancing
LOCK SHIELD	Connection	--	--	--	--	--	--
	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
BALL	Connection	Screwed/ VicPress	Grooved	Grooved	--	--	--

HEATING SYSTEMS (Heating Water, Condenser Water and Glycol)							
STYLE		0 - 50 mm	55 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
	Valve Item Number	9.1 / 6.8	6.9	6.9	--	--	--
	Function	Drains Angle & Isolation	Isolation	Isolation	--	--	--

COOLING SYSTEMS (Chilled Water and Glycol)							
STYLE		0 - 50 mm	55 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	1.5	1.5	1.5	1.5	1.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
BUTTER-FLY	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	7.1	7.1	7.1	7.1	7.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
BALAN-ING	Connection	--	Grooved / Flanged	Grooved / Flanged	Grooved / Flanged	Grooved / Flanged	Grooved / Flanged
	Valve Item Number	--	13.4 / 13.3	13.4 / 13.3	13.4 / 13.3	13.4 / 13.3	13.4 / 13.3
	Function	--	Circuit balancing	Circuit balancing	Circuit balancing	Circuit balancing	Circuit balancing
GLOBE	Connection	--	--	--	--	--	--
	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
GATE	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	2.6	2.6	2.6	2.6	2.6
	Function	--	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
GLOBE	Connection	--	--	--	--	--	--
	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
CHECK	Connection	--	Flanged	--	--	--	--
	Valve Item Number	--	Red White 435A	--	--	--	--
	Function	--	Check	--	--	--	--
CHECK	Connection	--	Grooved	Grooved	--	--	--
	Valve Item Number	--	3.7	3.7	--	--	--
	Function	--	Check	Check	--	--	--
SPRING CHECK	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	4.4	4.4	4.4	4.4	4.4 / 4.5
	Function	--	Check Condenser Water Pumps	Check Condenser Water Pumps	Check Condenser Water Pumps	Check Condenser Water Pumps	Check Condenser Water Pumps
PLUG	Connection	--	Flanged/Groove d	Flanged/Groove d	Flanged/Groove d	Flanged/Groove d	Flanged
	Valve Item Number	--	5.2 / 5.7	5.3 / 5.7	5.4 / 5.7	5.4 / 5.7	5.4
	Function	--	Balancing	Balancing	Balancing	Balancing	Balancing
LOCK	Connection	--	--	--	--	--	--

COOLING SYSTEMS (Chilled Water and Glycol)							
STYLE		0 - 50 mm	55 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
SHIELD	Valve Item Number	--	--	--	--	--	--
	Function	--	--	--	--	--	--
BALL	Connection	Screwed/ VicPress	Grooved	Grooved	--	--	--
	Valve Item Number	6.1 / 6.8	6.9	6.9	--	--	--
	Function	Isolation	Isolation	Isolation	--	--	--

STEAM AND HIGH TEMPERATURE WATER SYSTEMS TO 800 kPa ***(Steam, Condensate and Pumped Condensate)***							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	Screwed	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	1.1	1.5	1.5	1.5	1.5	1.5
	Function	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	Screwed	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	2.9	2.6	2.6	2.6	2.6	2.6
	Function	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
CHECK	Connection	Screwed	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	3.3	3.4	3.4	3.4	3.4	3.4
	Function	Check	Check	Check	Check	Check	Check
SPRING CHECK	Connection	Wafer	Wafer	Wafer	Wafer	Wafer	Wafer
	Valve Item Number	Call Watts	4.2	4.2	4.2	4.2	4.2
	Function	Check, Pump Discharge	Check, Pump Discharge	Check, Pump Discharge	Check, Pump Discharge	Check, Pump Discharge	Check, Pump Discharge

STEAM SYSTEMS Over 800 kPa ***(HP Steam, HP Drip, Blowdown, Continuous Blowdown, Boiler Feedwater)***							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE WITH VALVED BYPASS & DRAIN	Connection	--	--	--	Flanged	Flanged	Flanged
	Valve Item Number	--	--	--	1.7	1.7	1.7
	Function	--	--	--	HP Steam Header	HP Steam Header	HP Steam Header
GATE	Connection	Screwed	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	1.7	1.7	1.7	1.7	1.7	1.7
	Function	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	Screwed	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	2.5	2.7	2.7	2.7	2.7	2.7
	Function	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
CHECK	Connection	Screwed	Flanged	--	--	--	--
	Valve Item Number	3.2	3.5	--	--	--	--

STEAM SYSTEMS Over 800 kPa ***(HP Steam, HP Drip, Blowdown, Continuous Blowdown, Boiler Feedwater)***							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
	Function	Check	Check	--	--	--	--

PLUMBING (Cold Water (soft and hard), Hot Water and Hot Water Recirculation)							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	--	Screwed	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	1.1	1.5	1.5	1.5	1.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
BUTTER-FLY	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	7.1 / 7.6	7.1 / 7.6	7.1	7.1	7.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	--	Screwed	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	2.1	2.6	2.6	2.6	2.6
	Function	--	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
CHECK	Connection	--	Screwed/Grooved	Flanged/Grooved	Flanged	Flanged	Flanged
	Valve Number	--	3.3 / 3.7	3.4 / 3.7	3.4	3.4	3.4
	Function	--	Check	Check	Check	Check	Check
SPRING	Connection	--	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved
	Valve Item Number	--	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4 / 4.5
	Function	--	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump
BALL	Connection	VicPress	Grooved	Grooved	--	--	--
	Valve Item Number	6.8	6.9	6.9	--	--	--
	Function	Isolation	Isolation	Isolation	--	--	--

PLUMBING (Compressed Air) to 125 PSI							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	Solder	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	1.2	1.5	1.5	1.5	1.5	1.5
	Function	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
GATE	Connection	Screwed	--	--	--	--	--
	Valve Item Number	1.1	--	--	--	--	--
	Function	Isolation	--	--	--	--	--
BUTTER-FLY	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	7.1 / 7.6	7.1 / 7.6	7.1	7.1	7.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	Solder	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	2.2	2.6	2.6	2.6	2.6	2.6

PLUMBING (Compressed Air) to 125 PSI							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
	Function	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
GLOBE	Connection	Screwed	--	--	--	--	--
	Valve Item Number	2.1	--	--	--	--	--
	Function	Isolation/ Throttling	--	--	--	--	--
CHECK	Connection	Solder	Flanged/Groove d	Flanged/Groove d	Flanged	Flanged	Flanged
	Valve Item Number	3.1	3.4 / 3.7	3.4 / 3.7	3.4	3.4	3.4
	Function	Check	Check	Check	Check	Check	Check
CHECK	Connection	Screwed	--	--	--	--	--
	Valve Item Number	3.3	--	--	--	--	--
	Function	Check	--	--	--	--	--
SPRING	Connection	--	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved
	Valve Item Number	--	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4 / 4.5
	Function	--	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump
BALL	Connection	Screwed/ VicPress	Screwed/Groove d	Grooved	--	--	--
	Valve Item Number	6.1 / 6.8	6.1 / 6.9	6.9	--	--	--
	Function	Isolation	Isolation	Isolation	--	--	--

PLUMBING (Waste Water)							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	1.5	1.5	1.5	1.5	1.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	2.6	2.6	2.6	2.6	2.6
	Function	--	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
CHECK	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	3.4	3.4	3.4	3.4	3.4
	Function	--	Check	Check	Check	Check	Check

PLUMBING (Laboratory Water)							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	Screwed	Screwed	--	--	--	--
	Valve Item Number	1.6	1.6	--	--	--	--
	Function	Isolation	Isolation	--	--	--	--
GLOBE	Connection	Screwed	Screwed	--	--	--	--

	Valve Item Number	2.8	2.8	--	--	--	--
	Function	Isolation/ Throttling	Isolation/ Throttling	--	--	--	--
CHECK	Connection	Screwed	Screwed	--	--	--	--
	Valve Item Number	3.6	3.6	--	--	--	--
	Function	Check	Check	--	--	--	--

NATURAL GAS (Natural Gas)							
STYLE		0 – 50 mm	55 - 75 mm	100 – 150 mm	150 – 200 mm	200 – 250 mm	300 - 400 mm
PLUG	Connection	Screwed	Screwed	Screwed	Screwed	Screwed	Screwed
	Valve Item Number	5.5	5.6	5.6	5.6	5.6	5.6
	Function	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
BALL	Connection	Screwed					
	Valve Item Number	6.6					
	Function	Isolation					

FIRE (Standpipe and Sprinklers)							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 – 200 mm	200 - 250 mm	300 - 400 mm
BALL	Connection	Screwed/Grooved	--	--	--	--	--
	Valve Item Number	6.7 / 6.10	--	--	--	--	--
	Function	Isolation (UL)	--	--	--	--	--
GLOBE	Connection	Screwed	Flanged	--	--	--	--
	Valve Item Number	2.5	2.6	--	--	--	--
	Function	Isolation/ Throttling	Isolation/ Throttling	--	--	--	--
CHECK	Connection	Screwed	--	--	--	--	--
	Valve Item Number	3.2	--	--	--	--	--
	Function	Check	--	--	--	--	--
SPRING	Connection	--	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved	Wafer/Grooved
	Valve Item Number	--	4.3 / 4.6	4.3 / 4.6	4.3 / 4.6	4.3 / 4.6	4.3 / 4.6
	Function	--	Check (UL)	Check (UL)	Check (UL)	Check (UL)	Check (UL)
GATE	Connection	--	Grooved	Grooved	Grooved	Grooved	--
	Valve Item Number	--	1.9	1.9	1.9	1.9	--
	Function	--	Isolation	Isolation	Isolation	Isolation	--
BUTTER-FLY	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	7.4	7.4	7.4	7.4	7.4
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation

2.3 VALVE PRODUCT SCHEDULE

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR

1.0 GATE VALVES	1.1	B62 Bronze Construction, Solid Wedge Disc, Union Bonnet	125 Steam 200 WOG	Threaded or Soldered	Handwheel, Rising Stem
	1.2	B62 Bronze Construction, Solid Wedge Disc, Union Bonnet	200 PSI	Solder	Handwheel, Rising Stem
	1.3	Cast Iron, Solid Wedge Disc	1380 CWP	Flanged	Handwheel, Rising Stem
	1.4	Bronze Construction, Solid Wedge Disc, Bolted Bonnet	125 Steam 200 WOG	Flanged	Handwheel, Non-Rising Stem
	1.5	Cast Iron Construction, Bronze Fitted, Solid Wedge Disc, Bolted Bonnet	125 Steam 200 WOG	Flanged	Handwheel, OS & Y
	1.6	All stainless steel gate valve	1035 CWP	Threaded	Handwheel
	1.7	Cast steel construction, Hard Facing Trim, Solid Wedge Disc, Bolted Bonnet. Bypass where specified for service HP steam	Class 150	Flanged	Handwheel, OS & Y
	1.8	Bronze Construction, Union Bonnet, Solid Wedge Disc, Stainless Steel Seat	200 Steam 400 WOG	Screwed	Handwheel, Rising Stem
	1.9	Cast ductile iron construction, EPDM coated disc, brass stem	1725 kPa CWP	Grooved	Handwheel, Rising or Non-Rising stem.
	Approved acceptable manufacturers: Crane, Jenkins, Kitz -				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
2.0 GLOBE VALVES	2.1	Bronze Construction, Swivel Type Metal Disc, Screwed Bonnet	125 Steam 200 WOG	Screwed	Handwheel
	2.2	Bronze Construction, Swivel Type Metal Disc, Bonnet	125 Steam 200 WOG	Solder	Handwheel
	2.3	Bronze Construction, Renuable Teflon Disc, Swivel Type Disc Holer, Union Bonnet	125 Steam 200 WOG	Screwed	Handwheel
	2.4	Bronze Construction, Renuable Teflon Disc, Swivel Type Disc Holer, Union Bonnet	125 Steam 200 WOG	Soldered	Handwheel
	2.5	Bronze Construction, 420 S.S. Union Bonnet	2760 CWP	Screwed	Handwheel, Rising Stem
	2.6	Cast Iron Construction, Bronze trimmed, Bolted Bonnet	125 Steam 200 WOG	Flanged	Handwheel, OS & Y
	2.7	Cast steel construction, plug type disc, bolted bonnet, stellite trim	Class 150	Flanged	Handwheel, OS & Y
	2.8	All stainless steel globe valve	1035 CWP	Threaded	Handwheel
	2.9	Union Bonnet, Renewable Teflon Disc, Swivel Type Disc Holder, Screwed Ends	150 Steam 300 WOG	Screwed	Handwheel, Stem Rising
	Approved acceptable manufacturers: Crane, Jenkins, Nibco -				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
3.0 CHECK VALVES	3.1	Bronze Construction Y-Pattern, Regrind seating, Screwed Cap, Integral Disc	125 Steam 200 WOG	Solder	Swing
	3.2	Bronze Construction, T-Pattern Regrind Seating, Screwed Cap	4140 CWP	Threaded	Swing
	3.3	Bronze Construction Y-pattern, Regrind Seating, Screwed Cap, Integral Disc	125 Steam 200 WOG	Threaded	Swing
	3.4	Cast Iron Construction, Bronze Trimmed, Regrindable Disc, Bolted Cover	125 Steam 200 WOG	Flanged	Swing
	3.5	Cast Steel Construction, Stellite Trim	Class 150	Flanged	Swing
	3.6	All stainless steel check valve	1035 CWP	Screwed	Swing
	3.7	Cast ductile iron body, stainless steel trimmed, coupled cover.	2065 kPa CWP	Grooved	Swing
	Approved acceptable manufacturers: Crane, Jenkins, Nibco -				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
4.0 SPRING LOADED CHECK VALVES	4.1	Ansi B1.20.1, Forced Brass, 316 Stainless Steel Spring, NBR-70SH Rubber Disc	1965 CWP	Screwed	Spring
	4.2	Cast Iron Body to ASTM 48 Class 40, 316 Stainless Steel Disc, Viton Seat	125 Class	Wafer	Spring
	4.3	Cast Iron Body, Viton A seat, UL approved	1725 CWP	Wafer	Inconel X Spring
	4.4	Ductile Iron Body, Stainless Steel Spring and Shaft	2065 CWP	Grooved	Spring
	4.5	Ductile Iron Body, Stainless Steel Dual Disc, Spring, and Shaft, EPDM seat	1585 CWP	AGS Grooved	Spring
	4.6	Ductile Iron Body, Stainless Steel Spring and Shaft, UL approved.	2065 CWP	Grooved	Spring
	Approved acceptable manufacturers: Mueller, Nibco, Victaulic -				

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
5.1 PLUG VALVES	5.1	Eccentric, permanently lubricated, C1 body, resilient plug, SS Bearings, Viton/TFE U-ring seal, Isobutene – Isoprene plug facing	1200 CWP	Threaded	Lever c/w memory stop	
	5.2	Eccentric, Permanently Lubricated, C1 body, Resilient Plug, SS Bearings, Viton/TFE U-ring seal, Isobutene – Isoprene plug facing	1200 CWP	Flanged or Grooved	Lever c/w memory stop	
	5.3	Eccentric, Permanently Lubricated, C1 body, Resilient Plug, SS Bearings, Buna packing, Isobutene – Isoprene plug facing	1200 CWP	Flanged or Grooved	Removable Lever c/w memory stop	
	5.4	Eccentric, Permanently Lubricated, C1 body, Resilient Plug, SS Bearings, Buna packing, Isobutene – Isoprene plug facing	1200 CWP	Flanged or Grooved	Geared, Handwheel c/w memory stop	
	5.5	Tapered, Coated plug, C1 Body	1200 CWP	Threaded	Removable Lever	
	5.6	Tapered, Coated plug, C1 Body	1200 CWP	Flanged	Removable Lever	
	5.7	Eccentric, Ductile Iron Body, EPDM Coated Plug, Welded-in Nickel Seat, 316 SS Bearings	1200 CWP	Grooved	Removable Lever or Gear	
	Approved acceptable manufacturers: Rockwell, DeZurik, Victaulic -					

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
6.0 BALL VALVES	6.1	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out Proof stem	150 Steam 600 WOG	Screwed	Lever
	6.2	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out Proof stem	150 Steam 600 WOG	Screwed	Wing Handles
	6.3	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out Proof stem	150 Steam 600 WOG	Soldered	Lever
	6.4	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out XXXX stem	150 Steam 600 WOG	Soldered	Wing Handles c/w Memory Stop
	6.5	ANSI 150 All stainless steel ball valve	1970 CWP Kitz 150 UTRM (Reduced Bore)	Flanged	Worm Gear

	6.6	Forged Brass, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Forged Brass Ball, Teflon seats, Buna-N O-ring, CGA Approved	600 GAS	Screwed	Lever
	6.7	Forged Brass, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Forged Brass Ball, Teflon seats, Buna-N O-ring, UL Approved	600 GAS	Screwed	Lever
	6.8	Forged Brass, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Forged Brass Ball, Teflon seats,	2065 CWP	Vic-Press	Lever
	6.9	Cast Ductile Iron, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Steel Ball, TFE seats.	5515 CWP	Grooved	Lever or gear
	6.10	Cast Bronze, 2-piece Construction, Blow Out Proof Stem, Hard Chrome Plated Brass Ball, TFE seats, with Supervisory Switches. UL approved.	2410 CWP	Grooved / Threaded	Handwheel
	Approved acceptable manufacturers: Crane, Nibco, Newman Hattersley -				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
7.0 BUTTERFLY VALVES	7.1	Cast Iron Body, EPDM Resilient Seat, Bronze Disc, 416 SS Shaft, Bronze Bushings Ductile iron body, enamel coated body, EPDM pressure responsive seat.	200 2065 CWP	Lug Grooved	10 Position Lever 10 position lever or Gear
	7.2	Cast Iron Body, EPDM Resilient Seat, Bronze Disc, 416 SS Shaft, Bronze Bushings	200	Lug	Infinite Position Lever c/w Memory Stop
	7.3	Cast Iron Body, EPOM Resilient Seat, Bronze Disc, 416 SS Shaft, Bronze Bushings	200	Lug	Gear Wheet c/w Flag Indicator
	7.4	DI Body, Disc, and Shaft, EPDM Disc Coating, UL approved -	2065 CWP	Grooved -	Gear, Wheel, c/w Flag Indicator & Provision for Monitor
	7.5	DI Body, PPS Coated DI Disc, EPDM seal, SS Shaft	2065 CWP	AGS Grooved	Gear

	7.6	Cast Bronze Body, EPDM Coated Disc, Copper-Tube Dimension Ends.	2065 CWP	Grooved	Lever or Gear
	7.7	Grade CF8M Stainless Steel Body and Disc, Elastomer Seal, 316SS Stem.	2065 CWP	Grooved	Lever or Gear
	Approved acceptable manufacturers: Jenkins, Keystone, Crane-				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
8.0 RADIATOR VALVES	8.1	Bronze, Heavy Pattern, Composition Disc	200	Union	Handwheel
	8.2	Bronze, Heavy Pattern, Composition Disc	1380 WP @ 121ºC	Union	Lockshield c/w Memory Stop
	Approved acceptable manufacturers: Red-White/Toyo, Dahl				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
9.0 DRAIN VALVES	9.1	Hard Chrome Plated Ball, Cap and Drain	1380 WP @ 121ºC	Screwed X hose	Lever
	Approved acceptable manufacturers: Toyo, Kitz				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
10.0 NEEDLE VALVES	10.1	B62 Bronze Construction	2760 CWP	Screwed	Handwheel Rising Stem
	Approved acceptable manufacturers: Jenkins, WH Bolton, Crane				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
11.0 RELIEF VALVES	11.1	Bronze Body, Composition Disc	Heating Water to 1100 kPa	Screwed	Pressure
	11.2	Bronze Body, Composition Disc	Domestic water	Screwed	Temperature and Pressure
	11.3	Brass or Bronze Body, Teflon Disc, SS Spring	LP Steam	Screwed	Pressure
	Approved acceptable manufacturers: Sarco, Lunkenheimer				

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
12.0 DIFFERENTIAL PRESSURE RELIEF VALVES	12.1	Brass Body, SS Spring, EP Disc Seat, sizes to 30 mm	300 kPa	Screwed	
	12.2	Cast iron body, coated S.S. seal, viton diaphragm, seat, O-rings, sizes to 38 mm	1379 kPa	Screwed	24 VAC solenoid, normally closed

	12.3	Cast iron body, coated S.S. seal, viton diaphragm, seat, O-rings, sizes >= 50 mm	1379 kPa	Flanged	24 VAC solenoid, normally closed
	12.4	Epoxy coated ductile iron body, coated S.S. components, sizes >= 13 to 200 mm	1723 kPa	Screwed, Flanged	

VALVE TYPE	ITEM	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
13.0 CIRCUIT BALANCING VALVES	13.1	DZR brass (Ametal) copper alloy body, globe type, with EPDM seat, and venturi taps.	2065 kPa	Screwed	Handwheel with memory stop
	13.2	DZR brass (Ametal) copper alloy body, globe type, with EPDM seat, and venturi taps.	2065 kPa	Soldered	Handwheel with memory stop
	13.3	Ductile iron body, globe type, with EPDM seat, and venturi taps.	2065 kPa	Flanged	Handwheel with memory stop
	13.4	Ductile iron body, globe type, with EPDM seat, and venturi taps.	2065 kPa	Grooved	Handwheel with memory stop

Part 3 EXECUTION

3.1 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.

3.2 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-2010, Power Piping.

.2 ASTM International

.1 ASTM A125-96(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-10, 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 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 in accordance with Section 01 74 20.

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 SP 58.

.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 SP 58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ASME B31.1.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 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 structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP 69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies: As indicated on drawings.

.2 Steel brackets: As indicated on drawings.

.6 Hanger rods: threaded rod material to MSS SP 58:

.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.

.7 Pipe attachments: material to MSS SP 58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP 69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.

.10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed and FM approved.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, 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 SP 69.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

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

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops..

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 PLATFORMS AND CATWALKS

.1 To Section 05 50 00.

2.11 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.

2.12 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23.

.2 Submit structural calculations with shop drawings.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Plumbing piping: to National Plumbing Code.

.2 Fire protection: to National Fire Code and requirements of authority having jurisdiction.

.3 Gas piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

.7 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA 13-2009, Installation of Sprinkler Systems.

.2 National Building Code of Canada (NBC) 2010.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Provide system shop drawings complete with performance and product data.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

.5 Type EP5 – sound control underlayment 8mm minimum thick open cellular rubber mat reinforced with solid rubber particles bonded to fibreglass/cellulose backing with a density of 22lbs/cu.ft. and a minimum tensile strength of 45lbs.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on two layers of bonded 6 mm minimum thick ribbed neoprene acoustic pads; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Type M6 - restrained stable open spring: supported on three (3) layers of bonded 20 mm minimum thick rubber waffle pads; built-in resilient limit stops, removable spacer plates. Each spring shall be sized to limit a 20% compression. Hold down bolds for springs shall include a thick neoprene grommet at the bolt hole. Minimum length is 150mm with an allowable compression of 25mm, elongation of 16mm traverse movement of 16mm.

.7 Performance: as indicated.

2.6 FLEXIBLE CONNECTIONS

.1 Double sphere EPDM connector and expansion joint; multi-layerd tire cord fabric reinforcement with peroxide cured EPDM cover. Split baked enamel ductile iron floating flanges rated for 17Bar.

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 with deflection indicator.

.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.

2.9 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturer’s 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. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support shall have a 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 a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 TESTING

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93.

.2 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.3 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-B149.1-[10], 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.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14-2010, Standard for the Installation of Standpipe and Hose Systems.

1.2 SUBMITTALS

.1 Product Data: submit product data for each item specified.

.2 Submittals: in accordance with Section 01 33 00.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.3 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Dispose of unused paint material at official hazardous material collections site.

.3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size #5.

.2 Equipment in Mechanical Rooms: use size #9.

.5 Identification for PWGSC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CAN/CSA-B149.1

.2 Sprinklers: to NFPA 13.

.3 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°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
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. Supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. Return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Steam	Yellow	STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
Intermittent blow-off	Yellow	INT. BLOW-OFF
Continuous blow-off	Yellow	CONT. BLOW-OFF
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Compressed air (<700kPa)	Green	COMP. AIR LP kPa
Compressed air (>700kPa)	Yellow	COMP. AIR HP kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

Instrument air	Green	INSTRUMENT AIR

2.6 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.

2.7 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.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification in English.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

.1 Provide identification only after painting specified Section 09 91 23 has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.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 GENERAL

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 RELATED REQUIREMENTS

.1 Section 23 05 93.13 Testing, Adjusting, and Balancing of Fume Hoods

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 60 days of award of contract.

.2 Personnel to be member in good standing of AABC and/or NEBB.

.3 Provide documentation confirming qualifications, successful experience.

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 so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and 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 be 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 so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 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 all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 SITE VISITS

.1 Total of 14 site visits shall be made to correspond with the general monthly site meetings and phasing of the project as held by the Contractor. After each site visit, a written report shall be submitted to the Contractor and Consultant. Site visits shall commence after the start of air and liquid distribution work and be spread over the construction period to the start of the balancing work.

.2 A review of the installation and access to all valves, dampers, and equipment shall be made at the specified site visits and any additional dampers or valves required for proper balancing shall be forwarded in writing to be reviewed by the Consultant.

.3 Allow for 4 visits to site to adjust systems for seasonal changes during warranty. Coordinate time of visits with the Owner. Submit reports to Consultant.

.4 Begin balancing after equipment start-up and testing and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.9 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.

1.10 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.

1.11 SUBMITTALS

.1 Provide required information in accordance with Section 01 30 00 – Administrative Requirements and Section 01 70 00 – Execution.

.2 Provide proof of membership in the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB). Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

.3 Informational Submittals: Provide the following submittals electronically during the course of the work:

.4 Balancing Agenda:

.1 Submit balancing agenda to the Consultant and commissioning contractor for review at least sixty (60) days prior to the start of balancing work. Start balancing work only after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.

.3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.4 Sample Forms: Form showing application of procedures to typical systems.

.5 Prior to commencement of work on site, the balancing agent shall arrange with the Consultant, a pre-determined test area on site. This is to determine the accuracy of test equipment and to review the balancing methods outlined in the written, pre-approved balancing procedures.

.6 At the completion of balancing the first major air system the balancing agent shall notify the Consultant to re-visit the site to evaluate work completed to this time. Provide the Consultant with 5 days written notice, prior to request for site visit.

.7 Balance Report:

.1 Submit electronic copies of rough balancing reports to the Consultant for review, prior to on-site verification and acceptance of Project.

.2 Provide four (4) copies of final reports to contractor for inserting in Owner's Operating and Maintenance Manuals as described in Section 20 01 00.

.3 Include types, serial number, and dates of calibration of instruments in the reports.

1.12 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, caulking.

.5 All pressure, leakage, other tests specified elsewhere in Division 23.

.6 All 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, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.13 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 Consultant.

1.14 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Laboratory HVAC systems: plus 10%, minus 0%.

.2 Office and support space HVAC systems: plus 5%, minus 5 %.

.3 Hydronic systems: plus or minus 10%.

1.15 ACCURACY TOLERANCES

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

1.16 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.17 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

.3 Submit preliminary TAB Report and final TAB Report as indicated below.

1.18 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 Date testing work is performed.

.2 Details of instruments used.

.3 Details of TAB procedures employed.

.4 Calculations procedures.

.5 Summaries.

1.1 TAB REPORT

1.1.1 Format in accordance with referenced standard.

1.1.2 TAB report to show results in SI units and to include:

1.1.2.1 Project record drawings.
1.1.2.2 System schematics.

1.1.3 Submit 6 copies of TAB Report to Consultant for verification and approval, in English, in D-ring binders, complete with index tabs.

1.2 SYSTEM DATA

1.2.1 Air Handling Equipment

Design Data:

Total air flow rate;
Fan total static pressure;
System static pressure;
Motor kWHP, r/min, amps, Volts, Phase;
Outside air flow rate L/s (cfm);
Fan r/min;

Fan/kWHP;
Inlet and outlet, dry and wet bulb temperatures.

Installation Data:

Manufacturer and model;
Size;
Arrangement discharge and class;
Motor type, kWHP, r/min, voltage, phase, cycles, and load amperage;
Location and local identification data.

Recorded Data:

Supply Air Fan
- Fan 100% Outside Air
  Air flow rate;
  Fan total static pressure;
  System static pressure;
- Fan Full Return/Min O/A
  Air flow rate;
  Fan total static pressure;
  System static pressure;

Return Air Fan
- Fan 100% Exhaust Air
  Air flow rate;
  Fan total static pressure;
  System static pressure;
- Fan Full Return
  Air flow rate;
  Fan total static pressure;
  System static pressure;

Exhaust Air Fan
- Fan 100% Exhaust Air
  Air flow rate;
  Fan total static pressure;
  System static pressure;

System static pressure;
- At every fan section

Fan r/min;
For Axial Fans, note blade pitch angle;
Motor operating amperage;
Inlet and outlet, dry and wet bulb temperatures.

1.2.2 Duct Air Quantities - All mains supplying more than 10% of Volume, outside air return air and exhaust (maximum and minimum) major return air openings back to duct shafts.

Duct sizes;
Number of pressure readings;
Sum of velocity measurements;
Average velocity;
Duct recorded air flow rate;
Duct design air flow rate.

1.2.3 Air Terminal Devices (VAV and Zone boxes):

Outlet identification location and designation;
Manufacturers catalogue identification and type;
*Application factors;
Air flow at minimum position;
Air flow at maximum position
Air flow at purge mode

1.2.4 Air Inlet and Outlets:

Outlet identification location and designation;
Manufacturers catalogue identification and type;
*Application factors;
Design and recorded velocities;
Design and recorded air flow rates;
Deflector vane or diffuser cone settings.

* (Refer to 3.1.3 for supporting information)

1.2.5 Pumps

Design Data:

Fluid flow rate;
Total Head;
r/min;
kWHP, r/min, amps, volts, phase.

Installation Data:

Manufacturer and model;
Size;
Type drive;
Motor type, KWHP, r/m, voltage, phase, and full load amperage.

Recorded Data:

Discharge and suction pressures with secondary systems on both bypass and full circulation (full flow and no flow);
Operating head;
Operating water flow rate (from pump curves if metering not provided);
Motor operating amps (full flow and no flow);
r/min.

1.2.6 Expansion Tank

Design Data:

Size;
Capacity;
Pressure rating;

Installation Data:

Manufacturer, size, capacity;
Pressure reducing valve setting;
Pressure relief valve setting.

1.2.7 Heating Equipment (Baseboard, Unit heaters, etc.)

Design Data:

Heat transfer rate;
Fluid flow rate;
Entering and leaving fluid temperatures;
Fluid pressure drop.

Installation Data:

Manufacturer, Model, Type;
Entering and leaving fluid temperatures;
Capacity;
Pressure drops;
Flow rates.

Recorded Data:

Element type and identification (location and designation);
Entering and leaving fluid temperature (for varying outdoor temperatures);
Fluid pressure drop;
Fluid flow rate;
Pressure relief valve setting.

1.2.8 Heat Exchanger

Design Data:

Fluid flow rates (heated media, heating media);
Fluid type;
Inlet and outlet temperatures.

Installation Data:

Manufacturer, model, type;
Fluid flow rates (heated media and heating media);
Inlet and outlet temperatures;
Pressure relief valve setting.

Recorded Data:

Heating media entering flow rate;
Heated media leaving flow rate;
Entering and leaving temperatures (for varying outdoor temperatures) and pressures;
Steam pressure and temperature, and condensate temperature.

1.2.9 Boiler

Design Data:

Heating capacity;
flow rates and pressure drops;
Motor kWHP, voltage, phase, full load amps.

Installation Data:

Manufacturer and model;
Motor type, kWHP, r/min, voltage, phase, and full load amperage;
Liquid flow rates;
Liquid pressure drops;
Entering and leaving liquid temperatures.

Recorded Data:

Liquid flow rates;
Liquid pressure drops;
Entering and leaving liquid temperatures.

1.2.10 Air Heating and Cooling Equipment

Design Data:

Heat transfer rate;
Liquid and air flow rates;
Liquid pressure drop;
Air static pressure drop;
Entering and leaving liquid temperatures;
Entering and leaving air dry and wet bulb temperatures.

Installation Data:

Manufacturer, model, type;
Entering and leaving fluid flow and temperatures;
Entering and leaving air flow and temperatures;
Fluid and air side pressure drops.

Recorded Data:

Element type and identification (location and designation);
Entering and leaving air dry and wet bulb temperatures;
Entering and leaving water temperatures;
Liquid pressure drop;
Air static pressure drop;
Air and Liquid flow rates;
Adjusted temperature rise or drop.

1.2.11 Liquid Chiller

Design Data:

Cooling capacity;

Evaporator and condenser flow rates and pressure drops;
Motor kWHP, voltage, phase, full load amps.

Installation Data:

Manufacturer and model;
Motor type, kWHP, r/min, voltage, phase, and full load amperage;
Liquid flow rates;
Liquid pressure drops;
Entering and leaving liquid temperatures.

Recorded Data:

Liquid flow rates;
Liquid pressure drops;
Entering and leaving liquid temperatures.

1.2.12 Cooling Tower

Design Data:

Entering dry and wet bulb temperatures;
Water flow rate;
Water entering temperature;
Water leaving temperature;
External Static pressure;
Fan kWHP.

Installation Data:

Manufacturer and model;
Motor type, kWHP, RPM, Voltage, phase and full load amperage;
Water flow rates;
Entering dry and wet bulb temperature;
Fan RPM;
Entering water temperature;
Leaving water temperature.

Recorded Data:

Entering water temperature;
Leaving water temperature;
Entering air temperature wet and dry bulb;
Leaving air temperature wet and dry bulb;
Ambient temperature wet and dry bulb;
Fan RPM;
Fan motor RPM;
Fan sheave size;
Motor sheave size;
Belt size;
Water flow rates;
Air flow rates;
Fan motor amps, volts, phase, kWHP;
Nozzle pressure;

Make-up water volume per hour.

1.2.13 Domestic hot water recirculation system.

Design Data:

Fluid flow rate;
Total Head;
r/min;
kWHP, r/min, amps, volts, phase.

Installation Data:

Manufacturer and model;
Size;
Type drive;
Motor type, KWHP, r/m, voltage, phase, and full load amperage.

Recorded Data:

Discharge and suction pressures with secondary systems on both bypass and full circulation (full flow and no flow);
Operating head;
Operating water flow rate (from pump curves if metering not provided);
Motor operating amps (full flow and no flow);
r/min.

Balanced flow in recirculation loops.

1.2.14 Sound Level Data

Diagram or description of relationship of sound source and measuring instrument; scale reading;
Graph readings at each octave band frequency;
Calculate room N.C. levels.

1.19 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results to be at discretion of Departmental Representative.

.4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.20 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.21 COMPLETION OF TAB

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

1.22 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Smoke management systems:

.1 Test for proper operation of all smoke and fire dampers, sensors, and detectors, installed as component parts of air systems specified or modified within the scope of work.

1.23 POST- OCCUPANCY TAB

.1 Measure DBT, WBT (or %RH), air velocity and NC levels, in occupied zone of following areas:

.1 Laboratory H158, Laboratory L527, Laboratory L530

.2 Calibration Laboratory

.3 Wildlife Evidence Room

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 3 months of termination of Warranty Period.

Part 2 PRODUCTS

2.1 INSTRUMENT TEST PORTS

.1 Duct mounted instrument test port to be constructed of heavy duty 1.6 mm zinc-plated steel, with flat neoprene mounting gasket.

.2 Test port to have cam-lever handle with chain connected to base.

.3 Leakproof neoprene expansion plug to resist 275 kPa pressure when closed.

Part 3 EXECUTION

3.1 GENERAL PROCEDURE

.1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices

.2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:

.1 Determine and tabulate similar sized grilles being balanced for AK schedule.

.2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.

.3 AK factor from schedule, must be approved by Departmental Representative during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).

.4 No flow hoods are to be used for measurement of exhaust or return air grilles.

.4 Balancing contractor shall advise mechanical contractor of required revised pulleys, sheaves and impellor shavings to allow proper balancing of systems

.5 Where axial fans require blade pitch changes, this shall be the responsibility of the balancing contractor

.6 Where pump impellors require shaving, this shall be the responsibility of the mechanical contractor. All adjustments shall be by qualified millwright. All changes shall be documented and included as part of the balancing report

3.2 AIR SYSTEM PROCEDURE

.1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

.1 Ensure dampers or volume control devices are in fully open position

.2 Balance central apparatus to ±5% air flow

.3 Balance branches and mains as stated previously

.4 Recheck central apparatus

.5 Balance all terminal air outlets as stated previously

.6 Re-balance central apparatus to ±5%

.7 Recheck all air outlets.

.8 Perform acoustical measurements.

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.4 Take static pressure readings and air supply temperature readings at 10 points on each system.

.5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 4 for rectangular ducts, and 2 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse. Measure air quantities on each system.

.6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters

.7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.8 Verify all terminal unit factory settings for maximum air flow (and minimum if applicable). Adjust terminal unit controller if required. Record adjusted units.

.9 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. For laboratories, test pressure conditions inside lab and outside in corridor. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.10 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 10 Pa minimum and 20 Pa maximum shall be achieved, measured with negligible outside wind velocity

3.3 FIRE DAMPER VERIFICATION

.1 Visually inspect all fire dampers

.1 Installation is straight

.2 Wall angles properly installed

.3 Duct has break away connection

.4 Fire stopping material where used is properly installed

.5 Adequate access

.6 Clearance between sleeve and wall

.2 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.

.3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.

.4 If fire damper does not close properly, sheet metal trade to repair installation and balancing agency to retest.

.5 All fire damper tests shall be witnessed by two parties, certified by Contractor and endorsed by the testing personnel.

3.4 ACOUSTICAL MEASUREMENTS

.1 Provide full spectrum acoustical measurements for each major area as follows:

.1 Laboratories

.2 Offices

.2 Provide additional or repeat acoustical measurements as necessitated by final balancing of each space, system, or piece of equipment.

.3 Take measurements at maximum air volume conditions.

.4 Note room reflective conditions at time of readings. (i.e. furnishings, window coverings, etc).

3.5 FIRE DAMPER/FIRE STOP FLAP VERIFICATION

.1 Visually inspect all fire dampers and fire stop flaps:

.1 Installation is straight.

.2 Wall angles properly installed.

.3 Duct has break away connection.

.4 Fire stopping material where used is properly installed.

.5 Adequate access.

.6 Clearance between sleeve and wall.

.2 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.

.3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.

.4 If fire damper does not close properly, sheet metal trade to repair installation and balancing agency to retest.

.5 All fire damper tests shall be witnessed by two parties, certified by Contractor and endorsed by the testing personnel.

3.6 BALANCING OF HYDRONIC SYSTEMS

.1 Open all (excepting pressure bypass must be closed) valves to fully open position including balancing valves, isolation valves, and control valves.

.2 Execute air balance prior to initiating hydronic balance (if coils are provided)

.3 Remove temporary strainers and install permanent sheaves prior to commencing balancing of hydronic systems.

.4 Adjust flows through each boiler or chiller to ensure equal flow.

.5 Check and adjust flows and temperatures at inlet side of coils.

.6 Position and mark all automatic valves, hand valves and balancing cocks for design flow through all coils, connectors, and all items in system requiring circulation of liquid.

.7 Upon completion of flow readings and coil adjustments, mark setting and record data.

.8 Coordinate with the mechanical contractor shaving of impellor to operating condition on pumps larger than 1.5 kW.

.9 Ensure all bypass valves are tightly closed.

.10 After making all terminal unit adjustments, re-check settings at pumps. Re-adjust as required.

.11 Calibrate all pressure and temperatures gauges.

.12 For all parallel pumping systems, check all flows through boilers, chillers, heat exchangers, and pumps under the following situations:

.1 With two pumps operating

.2 With one pump operating - repeat for each pump

.3 With controls demanding no heating or cooling

.13 For each pump, plot maximum and minimum flows on curve.

.14 Verify pressure drops and flows through 3-way pressure control bypass valves at full operating range.

3.7 BALANCING AND ADJUSTING OF DOMESTIC WATER SYSTEMS

.1 Adjust PRV on main line to 570 kPa maximum.

.2 Balance domestic hot water recirculating system piping to ensure flow from all points in the system. Ensure all hot and cold supply shut off valves are fully open

1.3 BALANCING REPORT

1.3.1 Submit draft copies of rough balancing reports prior to final acceptance of project.

1.3.2 Include types, serial number and dates of calibration of instruments.

1.3.3 Record test data on a sepia made from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

1.3.4 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

1.3.5 Report shall be indexed as follows:

Air

Summary
Procedure
Instrumentation
Drawings
Equipment Summary
Fan Sheets
Fan Curves
Fan Profile Data
Static Data
Air Monitoring Station Data
Traverse Data and Schedule
Terminal Unit Summary
Outlet Data Summary and Schematics (per system)
Building Schematic
Building Pressurization Data
Weather Conditions at Time of Test

Liquid

Summary
Procedure
Instrumentation
Drawings
Pump Data
Pump Curves
Flow Stations
Coils
Equipment Data
Element Data Summary and Schematics (per system)

3.8 PERFORMANCE VERIFICATION

.1 All Testing and Balancing work is to be coordinated with the Commissioning requirements of Section 01 91 13.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC Systems.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/ASHRAE 110-1995, Method of Testing Performance of Laboratory Fume Hoods.

.2 ANSI/AIHA/ASSE Z9.5-2012, Laboratory Ventilation.

.2 Public Works and Government Services Canada (PWGSC)

.1 PWGSC MD15128 2008, Laboratory Fume Hoods.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Contract Conditions and Section 01 33 00.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Record Documentation:

.1 Submit list of materials used in fume hood work.

1.5 QUALITY ASSURANCE

.1 Test Agency: fume hood tests to be performed by qualified independent testing agency with proven experience in Work of this Section and in accordance with PWGSC MD15128.

.2 Test Agency Qualification: submit proof of qualifications to Departmental Representative to demonstrate:

.1 Minimum 3 years experience in testing of fume hoods.

.2 Attendance at ASHRAE 110 Testing Workshop.

Part 2 PRODUCTS

2.1 TESTING EQUIPMENT

.1 Test equipment to ANSI/AIHA/ASSE Z9.5 and PWGSC MD 15128.

.2 Data logger:

.1 Speed: 10 Hz or better.

.2 Memory: sufficient to allow data collection for duration of test.

.3 In-duct flow sensor to measure flow response:

.1 Speed: 10 Hz.

.2 Range: 95 L/s to 950 L/s.

.3 Accuracy: ± 5%.

.4 Thermal anemometer:

.1 Mounting: on stand with probe fixed at each traverse grid location.

.2 Include: output recorded for 20 seconds minimum at a rate of one reading/second on data logger.

.3 Accuracy:

.1 Below 0.50 m/s: ± 0.025 m/s.

.2 0.50 m/s and over: ± 5%.

.5 Detector for tracer gas containment:

.1 Type: continuous reading.

.2 Minimum Detectable Level (MDL): 0.01 ppm.

.3 Accuracy: concentrations below 0.1 ppm: ±25%; concentrations above 0.1 ppm: ±10%.

.6 Smoke generator:

.1 Use smoke generator and diffuser complying with PWGSC MD15128.

Part 3 EXECUTION

3.1 AS INSTALLED (AI) AND INTEGRATED SYSTEMS TESTS

.1 Perform AI and integrated systems tests as follows:

.1 After entire laboratory HVAC and exhaust systems have been tested and balanced (TAB), and TAB and Performance Verification (PV) reports have been submitted and accepted.

.2 HVAC and exhaust systems are in full operation.

.3 Room temperatures are maintained between 22 degrees C and 24.5 degrees C., recorded and submitted with fume hood test documentation.

.4 At specified laboratory space pressurization.

.5 Under deviation of space pressurization due to laboratory door opening and closing, change of laboratory operating modes, upset conditions, and other causes of change in laboratory air pressure.

.6 As part of commissioning of integrated HVAC and exhaust systems and laboratory space pressurization tests included in commissioning process.

.2 After installation, test each fume hood to ANSI/ASHRAE 110 and PWGSC MD15128 at design sash position to ensure compliance with design criteria in PWGSC MD15128.

3.2 "AI" TESTS FOR AND VAV FUME HOODS

.1 Cross draft tests:

.1 Test air currents external to fume hood to PWGSC MD15128.

.2 Ensure velocity of cross draft does not exceed 50% of average face velocity.

.3 Record measurements as follows:

.1 Using thermal anemometer take readings 1.5 m above floor, 500 mm from sash, at centre, and left and right posts of fume hood.

.2 Take readings at 1 reading/second, recorded to obtain average, and maximum and minimum values over a duration of 20 seconds at each location.

.3 Ensure that [project authority] reduces excessive values to less than 50% of average face velocity before proceeding with further fume hood testing.

.2 Visualization (smoke) tests:

.1 Extent of tests and performance criteria: to PWGSC MD15128.

.3 Face velocity and flow response test pass ratings: to PWGSC MD15128 and ANSI/ASHRAE 110.

.1 Average face velocity for CAV bypass fume hoods: 0.5 m/s

.2 Average face velocity for high performance fume hoods: 0.35 m/s, with no reading less than 0.25 m/s.

.3 VAV face velocity and flow response tests:

.1 Average face velocity at design sash position: 0.5 m/s

.2 Average face velocity with sash at 66% of design sash position: 0.5 m/s ±0.025 m/s

.1 Variation allowed for individual readings: ±20%

.3 Average face velocity with sash at 33% of design sash position: 0.5 m/s ±0.025 m/s.

.1 Variation allowed for individual readings: ±20%

.4 Response time: time to reach 90% of the average steady state value: within 5 seconds of initial sash movement

.5 Test for VAV minimum flow with sash closed: to ANSI/AIHA/ASSE Z9.5 capable of maintaining 375 air changes per hour.

.4 Tracer Gas tests:

.1 Performance criteria: to PWGSC MD15128.

.2 Conduct tests at target average face velocity.

.3 Use approved tracer gas.

.4 Perform tests with probe at height of 560 mm above work surface.

.5 Leakage with sash at normal operating position:

.1 Average leakage: 0.05 ppm maximum.

.2 Peak reading: 0.25 ppm.

.6 Leakage with sash in fully open position:

.1 Average leakage: 0.05 ppm maximum.

.2 Peak reading: 0.25 ppm.

.7 Peripheral scan:

.1 Record significant peak readings and their locations.

.2 Record 30 second rolling averages.

.3 Maximum 0.25 ppm for any 30 second rolling average.

.4 Include readings in test report.

.8 Sash Movement Effect (SME), to determine potential for escape after movement of sash to ANSI/ASHRAE 110 procedures:

.1 Maximum 45 second rolling average: 0.05 ppm.

.5 Conduct VAV Response Tests, Stability Tests and SME simultaneously for VAV fume hoods.

3.3 AS USED (AU) TESTS WITH LAB APPARATUS IN PLACE

.1 Repeat tracer gas tests.

3.4 FUME HOOD MONITOR AND ALARM TESTS

.1 Fume Hood Monitor:

.1 Provide 3 point calibration.

.2 Ensure each monitor initiates alarms (audible, visual, and BMS) when unsafe velocity conditions occur.

.3 Ensure monitor readings are displayed in metres per second, to 2 decimal places.

.2 Fume Hood Monitor/Alarm testing:

.1 Monitor accuracy test: ensure monitor is accurate within 5% of average face velocity.

.2 Alarm enunciation test: ensure alarm occurs beyond ±20% of design flow set point.

.3 Alarm response enunciation test: ensure alarm delay is 10 seconds maximum.

3.5 FUME HOOD STATIC PRESSURE TEST

.1 With sash at design position and face velocity at target setting, fume hood static pressure: less than 62 Pa.

3.6 NOISE LEVEL TEST

.1 With sash at design position and face velocity at target setting, noise level at working position in front of fume hood: less than 70 dBA.

3.7 VERIFICATION LABELS

.1 Affix label to front of fume hood indicating verification, name of testing agency, and date.

3.8 COMMISSIONING - INTEGRATED SYSTEMS TESTS

.1 Do commissioning tests in accordance with Section 01 91 13.

.2 Fume hood testing to commence only after laboratory HVAC systems are fully commissioned, including calibration of airflow controls, calibration of automatic temperature controls, balance of air supply, completion of duct traverse on each fume hood exhaust duct, and completion of an air balance of the total exhaust flow.

.3 Test fume hoods in conjunction with complete laboratory integrated HVAC and exhaust systems commissioning testing including, room air flow patterns, temperature, humidity, pressurization, noise, and vibration.

3.9 REPORTS

.1 Ensure test reports are signed by testing agency before submitting to Departmental Representative.

3.10 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

3.11 PROTECTION

.1 Protect adjacent materials from work associated with testing and maintenance of fume hoods.

END OF SECTION

Part 1 GENERAL

1.1 GENERAL

.1 Ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment or fans to be pressure tested for leaks.

1.2 TIMING

.1 Ducts to be tested before installation of insulation or any other form of concealments.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.3 EXCLUSIONS

.1 Flexible connections to VAV boxes.

1.4 REFERENCES

.1 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.5 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested to be consistent with capacity of test equipment.

.2 Section of duct to be tested to include:

.1 Fittings, branch ducts, tap-ins.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.4 Base partial system leakage calculations on Reference Standard.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

1.6 TESTING AGENCY

.1 Installing Contractor.

1.7 VERIFICATION

.1 To be verified by project Commissioning Authority in accordance with specification section 01 91 13.

1.8 TEST INSTRUMENTS

.1 Testing agency to provide instruments for tests.

.2 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.

.5 Flexible duct for connecting to ductwork under test.

.6 Smoke bombs for visual inspections.

.3 Test apparatus to be accurate to within +/- 3 % of flow rate and pressure.

.4 Submit details of test instruments to be used to Departmental Representative at least one month before anticipated start date.

.5 Test instruments to be calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

.6 Instruments to be re-calibrated every six months thereafter.

1.9 SYSTEM LEAKAGE TOLERANCES

.1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 Small duct systems up to 250 Pa: Leakage 2 %.

.2 Terminal box and duct on downstream side of terminal box: Leakage 2 %.

.3 Large low pressure duct systems up to 500 Pa: Leakage 2 %.

.4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: Leakage 1 %.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

1.10 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and system components such as VAV boxes, duct heating Leakage: 5%.

1.11 REPORT FORMS

.1 Submit proposed report form and test report format to Departmental Representative for approval at least one months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.

1.12 PRESSURE TEST REPORTS

.1 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:

.1 Schematic of entire system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

.2 Include test reports in final TAB report.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Contractor to bear the cost of remedial repair measures and additional testing if results do not meet tolerances stated in the specifications.

.2 Testing results to be included in Operations and Maintenance manual in accordance with section 01 78 00.

END OF SECTION

Part 1 GENERAL

1.1 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/IES 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-10, 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-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.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 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.

.4 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations, special handling criteria, installation instructions, and cleaning procedures.

1.3 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, member of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, and ULC markings.

.3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in Part 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in Part 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.1 Maximum VOC limit to GSES GS-36.

.3 Aluminum:

.1 To ASTM B209M with 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.

.1 Stainless steel:

.5 Type: 316.

.6 Thickness: 0.25 mm sheet.

.7 Finish: Smooth.

.8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

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

.1 Maximum VOC limit to GSES GS-36.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

.6 Tape: self-adhesive, aluminum, 50 mm wide minimum.

.7 Contact adhesive: quick-setting

.1 Maximum VOC limit to GSES GS-36.

.8 Canvas adhesive: washable.

.1 Maximum VOC limit to GSES GS-36.

.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 both faces of insulation.

.12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and 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.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	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
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
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
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI approved; IESNA co-sponsored.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-1, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.7 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.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), 1992, 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): Mechanical Insulation Best Practice Guide(Revised 2005).

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings

.4 ULC-S702.2-10, Standard for Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.5 QUALITY ASSURANCE

.1 Qualifications:

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

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

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.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Cold Piping: Formed fine fibrous glass or formed mineral fibre pipe insulation meeting requirements of ULC S702; with factory applied vapour barrier jacket, factory moulded to conform to piping and as follows:

.1 K Value: Maximum 0.033 W/m°C at 24°C

.2 Service Temperature: 4°C to 100°C

.2 Hot Piping: Formed fine fibrous glass or mineral fibre pipe insulation meeting requirements of ULC S702; with factory applied general purpose jacket, factory moulded to conform to piping and as follows:

.1 K Value: Maximum 0.033 W/m°C at 24°C

.2 Service Temperature: Up to 150°C

.3 Refrigerant Piping: Foamed plastic of closed cell structure or closed cell elastomer meeting requirements of ULC S704 and as follows:

.1 K Value: Maximum 0.04 W/m°C at 24°C

.2 Maximum Water Vapour Transmission Rating:

.1 Unjacketed: 0.1 perm

.2 Jacketed: 0.1 perm

.4 Fire Retardant Insulation for PVC Piping: Formed fine fibrous glass or mineral fibre pipe insulation with cover material having flame spread 0 and smoke developed rating of 35 or less, plenum rated where exposed in return air installations or exposed ceiling installations.

2.3 EQUIPMENT INSULATION

.1 Hot Equipment: Rigid fibrous glass or mineral fibre insulation meeting requirements of ULC S702 and as follows:

.1 K Value: Maximum 0.033 W/m°C at 24°C

.2 Service Temperature: -14°C to 200°C

.2 Cold Equipment except Chillers: Rigid fibrous glass or mineral fibre insulation meeting requirements of ULC S702; with factory applied reinforced aluminum foil vapour barrier and as follows:

.1 K Value: Maximum 0.033 W/m°C at 24°C

.2 Service Temperature: -10°C to 100°C

.3 Chillers: Foamed plastic of closed cell structure or closed cell elastomer meeting requirements of ULC S704 and as follows:

.1 K Value: Maximum 0.04 W/m°C at 24°C

.2 Maximum Water Vapour Transmission Rating:

.1 Unjacketed: 0.1 perm

.2 Jacketed: 0.1 perm

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, 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.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting on mineral wool, to ASTM C449.

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 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.9 JACKETS

.1 Canvas: 220 g/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive in accordance with ASTM C921. Wheat or vegetable based adhesives will not be permitted.

Gauge Number	MSG Nominal Steel Core Thickness	Nominal Sheet Aluminum Thickness
8	4.2 mm	--
10	3.4 mm	--
12	2.7 mm	2.1 mm
14	1.9 mm	1.6 mm
16	1.5 mm	1.3 mm
18	1.2 mm	1.0 mm
20	0.9 mm	0.8 mm
22	0.8 mm	0.6 mm
24	0.6 mm	0.5 mm
26	0.5 mm	--
28	0.4 mm	--
29	0.35 mm	--
30	0.30 mm	--

.2 Aluminum: Meeting requirements of ASTM B209 and as follows:

.1 Thickness:

.1 Piping: Nominal 0.5 mm sheet

.2 Equipment, Valves and Fittings: Nominal 0.8 mm sheet

.3 Installations in Close Proximity to Occupied Areas: Nominal 0.8 mm sheet

.2 Finish: Smooth.

.3 Joining: Longitudinal and circumferential slip joints with 50 mm laps.

.4 Fittings: 0.5 mm thick die shaped fitting covers with factory attached protective liner.

.5 Metal Jacket Banding and Mechanical Seals: Stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.6 Exterior Installations: Include integral moisture barrier and weatherproof lap seals and fastenings.

.3 Polyvinyl Chloride (PVC): One-piece moulded type and sheet meeting requirements of CGSB-51.53 with pre-formed shapes as required and as follows:

.1 Colours: Match adjacent finish paint

.2 Service Temperature Range: -20°C to 65°C

.3 Moisture Vapour Transmission: 0.02 perm

.4 Thickness: 0.35 mm

.5 Fastenings:

.1 Solvent weld adhesive compatible with insulation for lap and joint seals

.2 Tacks

.3 Pressure sensitive vinyl tape of matching colour

.4 Interior: UV rated materials in areas exposed to fluorescent fixtures

.5 Exterior: UV rated material minimum 0.5 mm thick

.4 ABS Plastic: One-piece moulded type and sheet with pre-formed shapes as required and as follows:

.1 Colours: Match adjacent finish paint

.2 Service Temperature Range: -40°C to 82°C

.3 Moisture Vapour Transmission: 0.012 perm

.4 Thickness: 0.750 mm

.5 Fastenings:

.1 Solvent weld adhesive compatible with insulation for lap and joint seals

.2 Tacks

.6 Locations: Exterior use only

.5 REMOVABLE INSULATION COVERS

.1 General:

.1 All Covers shall be sewn, stapled or" hog-ringed" covers shall not be acceptable.

.2 Covers shall conform to the configuration of the items being insulated.

.3 Covers shall include openings for all protrusions such as pipes, packing glands on valves and expansion joints, hangers, supports, instrument lines, and other appurtenances.

.4 Covers shall be designed so that no force bending or folding of the cover is necessary for installation.

.5 Minimum 50mm wide flaps at terminal ends are to be provided to overlap adjacent covers to ensure a good heat seal.

.6 Parting seems shall be at the installed low points (gravitational bottom) of the cover to allow drainage without the use of weep tubes or grommets.

.7 Valve bonnets are to be covered, but packing glands shall remain exposed.

.8 Valve covers are to be designed such that the bonnet section is sewn to the body section. For larger valves, the cover may be fabricated in two sections, each section containing one half of the valve body and bonnet.

.9 Covers with a weight of 18.1 Kg or less are to be fabricated in one piece.

.10 Covers with a weight of more than 18.1 Kg are to be fabricated in more than one piece.

.2 Insulation Core:

.1 The insulation core shall be fabricated in one piece, wherever possible.

.2 To prevent insulation settlement, the insulation core shall be secured within the jacket through the weather barrier (outer jacketing), the insulation, and the liner (inner jacketing).

.3 Insulating cores with more than one piece shall have staggered joints to prevent hot spots and heat loss. The joint edges shall be butted together and extra securement provided at those edges.

.4 Insulation core shall be comprised of 50mm thick fiberglass insulation of non-combustible wool with resilient inorganic glass fibers bonded with a thermosetting resin. Insulation density to be 38 Kg/m³. Insulation thermal conductivity to be 0.044W/m.°C at a mean temperature of 100°C.

.3 Jacket:

.1 The jacket shall be fabricated in one piece, wherever possible.

.2 Gusset walls shall be required for covers with core insulation thickness in excess of 25mm.

.3 All seams, except the final closing seam, shall be inside seams. The jackets are to be sewn inside out, then turned correct side out before inserting the insulation core. The final closing seam shall be sewn on the exterior of the jacket. Seams shall be sewn coated fiberglass thread or coated stainless steel thread.

.4 Machine stitching shall be used for all sewing. Sewing shall be 6-8 stitches per centimeter.

.5 Draw cords are to be placed along the outer edge of the flap and the outer edge of the flap then rolled back inside and double stitched.

.6 Draw cords are to be of sufficient length to allow 150mm of cord to protrude from each side of the flap.

.7 The inner and outer jacket shall be comprised of a fiberglass fabric impregnated with silicone rubber. The silicone rubber shall be flame retardant and suitable for high temperature usage. Outer jacket density shall be 595 gms/m².

.4 Securement devices:

.1 The securement belts and D-ring belts shall be of the same material as the weather barrier (exterior jacket).

.2 The belts shall be placed 50mm back from the parting seams and on 150mm centers.

.3 Fire retardant fastening shall be used to secure belt to the weather barrier after the belt passed through the Stainless Steel D-rings.

.5 Identification tags:

.1 Each cover shall be identified by a permanently attached stainless steel tag.

.2 An identification legend shall be mechanically embossed into the tag.

.3 The tags shall be located in the same areas on similar type covers.

.4 Should a cover require more than one piece for its construction, each piece to be identified and numbered (i.e. 1of 3).

.5 Each tag shall include at least the following information, but may also include any pertinent information required by the end user.

.1 Type of item being covered.

.2 Location of item.

.3 Recording and tracking information.

.6 Warranty:

.1 Provide a 5-year product Warranty

.7 Acceptable manufacturers:

.1 Advanced Industrial Systems Inc., Thermo Help Canada Inc., Advanced Thermal Corp.

2.10 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Section 07 92 10.

2.11 ACCESSORIES

.1 Canvas Lagging Adhesive: Compatible with insulation and compliant with requirements for ULC listed dilute fire retardant lagging adhesive, washable type.

.2 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum

.3 Contact Adhesive: Quick setting type

.4 Tie wire: 1.5 mm diameter stainless steel

.5 Bands: Stainless steel, 19 mm wide, 0.6 mm thick

.6 Thermal Insulating and Finishing Cement: Hydraulic setting or Air drying for use on mineral wool meeting requirements of ASTM C449.

.7 Vapour Retarder Lap Adhesive: Water based, fire retardant type, compatible with insulation.

.8 Interior Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.

.9 Exterior Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation; fibrous glass reinforcing fabric; untreated 305 g/m2.

.10 Sealants: Joint and weatherproofing sealants of type compatible with adjacent materials and as specified in Section 07 92 00 - Joint Sealants.

.11 All steam piping and any piping over 150mm (6”) shall be supported with a calcium silicate settle at each hanger.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

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

3.3 INSTALLATION

.1 Install insulation and recovery jacket in accordance with TIAC Best Practices Guide, manufacturer’s written instructions and requirements of this specification.

.2 Install insulation so that it is continuous through inside walls; pack around pipes with fireproof self supporting insulation material, properly sealed in accordance with Section 07 84 00.

.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; hangers and supports must be outside vapour retarder jacket.

.5 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided at supports and hanger locations.

.6 Cold systems:

.1 Insulate complete system including, but not limited to:

.1 Piping

.2 Fittings

.3 Valves

.4 Unions

.5 Flanges

.6 Victaulic Couplings and fittings

.7 and strainers

.2 Piping: Seal lap joints with 100% coverage of vapour barrier adhesive; seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive; apply hydraulic insulating cement for fittings and valves or apply factory fabricated insulation half shells, seal all laps and joints.

.3 Do not insulate flexible connections and expansion joints.

.4 For piping 25mm or smaller, insulation is not required on strainers, control valves and balancing valves.

.5 Terminate insulation bevelled to the pipe and sealed.

.7 Hot systems:

.1 Insulate:

.1 Piping

.2 Fittings

.3 Valves

.4 Victaulic pipe fittings such as tees and elbows

.2 Do not insulate:

.1 Unions

.2 Flanges (except on flanged valves)

.3 Strainers

.4 Flexible connections

.5 Expansion joints;

.6 Victaulic couplings directly connected to equipment to facilitate equipment replacement or removal.

.3 For piping 25mm or smaller, insulation is not required on strainers, control valves and balancing valves.

.4 Terminate insulation bevelled to the pipe and sealed.

.5 Piping: Apply hydraulic insulating cement or apply factory fabricated insulation half shells for fittings and valves; flare-out staples may be used to secure jacket laps on hot systems applied on 100 mm centres.

.1 Insulate Victaulic couplings with pre-formed removable insulation.

.8 Refrigerant Piping: Cover fittings and valves with equivalent thickness of pipe insulation material; apply with edges tightly butted; seal joints with sealant.

.9 Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by metal bands and as follows:

.1 Weld on suitable anchors where necessary.

.2 Provide sufficient clearance around openings for normal operation of equipment.

.3 Finish surface of cold equipment insulation with vapour barrier jacket sealed with vapour barrier adhesive.

.4 Make uneven surfaces smooth with insulating cement.

.10 Chillers: Insulate evaporator, waterboxes and tube sheets, compressor suction elbow, suction cover and all cold surfaces.

.11 Cold System Pumps: insulate pumps up to motor shaft and all components exposed to system fluid.

3.4 FINISHING

.1 Finish insulation neatly at hangers, supports and other protrusions.

.2 Provide recovering jackets on exposed insulation throughout, including equipment rooms:

.3 Interior Exposed Finishing Applications, in accordance with TIAC CPF/1:

.1 Apply factory integral service jacket to receive treated fabric jacket applied using recommended fabric adhesive.

.2 Cover fittings, valves and strainers not finished with PVC covers with a hard coat cement and finished with treated fitting fabric applied with using recommended fabric adhesive.

.3 Locate insulation seams in least visible locations.

.4 Finish fabric with one (1) coat of fabric coating.

.4 Interior Concealed Finishing Applications in accordance with TIAC CPF/2:

.1 Leave insulation on concealed piping left as factory finished with no further finish required.

.2 Apply pipe insulation with an integral all service jacket.

.3 Secure jacket using appropriate fastenings on 100 mm centres.

.4 Locate insulation seams on piping on side of the pipe visible to access point of concealed space, such as: underside of pipe in concealed ceiling applications.

.5 Cover longitudinal and circumferential joints with jacket finishing tape neatly applied or secure jacketing using integral self sealing lap and self sealing circumferential joint strips depending on system used.

.6 Cover fittings, valves and strainers not finished with PVC covers with a hard coat cement and finish with treated fitting fabric applied with fabric adhesive.

.5 Exterior Exposed Finishing Applications (Metal Recovery Jacket), in accordance with TIAC CPF/3:

.1 Apply aluminum jacket over the pipe insulation using necessary fastenings on 150 mm centres.

.2 Apply metal jacket or preformed metal fittings over insulated fittings, valve bodies, valve bonnets, strainers and flanges to provide a complete jacket system.

.3 Lap circumferential joints 50 mm minimum and seal with compatible waterproof lap cement

.4 Lock form longitudinal joints and seal.

.5 Locate metal jacket seams in least visible locations.

.6 Secure with recommended fastenings.

.6 Interior/Exterior Exposed Finishing Applications (PVC Recovery Jacket), in accordance with TIAC CPF/4:

.1 Apply PVC Jacket over the pipe insulation using necessary fastenings on 100 mm centres.
.2 Cover longitudinal and circumferential joints with finishing tape neatly applied.
.3 Apply PVC jacket or preformed PVC fitting covers over insulated fittings, valve bodies, valve bonnets, strainers and flanges to provide a complete jacket system.
.4 Locate PVC jacket seams in least visible locations.
.5 Secure with appropriate fastenings and jacket finishing tape.

.7 Exterior Concealed, in accordance with TIAC CPF/5: Apply 2 ply weatherproof coating to insulated surfaces:

.1 First Ply: Apply minimum 1 litre per 1.5 m length of pipe weatherproof coating applied to insulated surfaces, increase application rate based on pipe diameter and manufacture's recommendations.
.2 Embed a layer of reinforcing membrane while still wet.
.3 Second Ply: Apply minimum 1 litre per 1.5 m length of pipe weatherproof coating applied to insulated surfaces, increase application rate based on pipe diameter and manufacture's recommendations.

3.5 INSULATION INSTALLATION THICKNESS SCHEDULE

.1 Insulation thicknesses shall confirm with ASHRAE 90.1 2010 or at a minimum be as follows;

.1 Insulation thicknesses listed below are based on based on Maximum K Value of least efficient insulation materials such as glass fibre and mineral fibre; thickness can be decreased for higher efficiency insulation materials such as polyurethane while maintaining overall K Value for the installation:

Piping or Equipment	Pipe Sizes mm	Insulation Thickness mm	Recovery Jacket
Chilled Water Piping	13 to 25 32 and over	25 38	Canvas (shafts) PVC (exposed areas)
Domestic Cold Water and RO Water Piping	13 to 25 32 and over	25 38	Aluminum (exterior) Canvas (shafts) PVC (exposed areas)
All Piping to be heat traced	13 to 20 25 to 150 200 and over	15 25 38	Aluminum (exterior) Canvas (shafts) PVC (exposed areas)

Piping or Equipment	Pipe Sizes mm	Insulation Thickness mm	Recovery Jacket
Domestic Hot Water Supply and Recirculation Piping	13 to 32 40 and over	25 38	Canvas (shafts) PVC (exposed areas)
Domestic Hot Water Supply and Recirculation Piping (through unconditioned spaces)	13 to 50 65 to 100 125 and over	50 65 75	Canvas (shafts) PVC (exposed areas)
Glycol Heating Piping	13 to 30 40 and Over	25 50	Canvas (shafts) PVC (exposed areas)
Hot Water Heating Piping; Do not insulate within Radiation Enclosures except for mains	13 to 30 40 and Over	25 50	Canvas (shafts) PVC (exposed areas)
Refrigerant Piping	13 to 20 25 to 150 200 and Over	25 25 38	Aluminum (exterior) Canvas (shafts) PVC (exposed areas)
Chilled Water Pumps	Removable Insulation Cover	65	n/a
Chillers		19	n/a
Chilled Water Storage Tanks	Removable Insulation Cover	65	n/a
Plate and Frame Heat Exchangers (hot and cold)	Removable Insulation Cover	65	n/a
Air Separators	Removable Insulation Cover	38	n/a
Low Pressure Steam and Condensate	13 to 80 100 and over	65 75	Canvas
High pressure steam	13 to 20 25 to 30 40 and over	75 100 125	Canvas
Note: Pipe insulation for piping installed in partitions within conditioned spaces can be reduced by 25mm but not to thickness below 25mm.			

3.6 REMOVABLE INSULATION COVERS

.1 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.1 Removable insulation covers shall be provided for the following:

.1 Hydronic heating and chilled water system pump assemblies:-pumps, suction diffusers, triple duty valves.

.2 Hydronic heating and chilled water system valves NPS 2½ and larger -gate, globe and butterfly.

.3 Hydronic heating and chilled water system flex connections, expansion joints.

.4 Hydronic heating and chilled water system expansion tanks.

.5 Hydronic heating and chilled water system air separators.

.6 Hydronic heating and chilled water system plate and frame heat exchangers.

.7 Hydronic heating and chilled water system shell and tube heat exchangers removable heads.

.8 Balancing valves NPS 2½ and above.

.9 Two-Way Control valves NPS 2½ and larger.

.10 Three-Way Control valves NPS 2½ and larger.

.11 Steam traps.

.12 Steam control vavles.

3.7 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 REFERENCES

.1 ASTM E202-09, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02.

1.3 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Timing:

.1 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 in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Boiler and/or chiller operation.

.3 Pressure bypass open/closed.

.4 Control pressure failure.

.5 Maximum heating demand.

.6 Maximum cooling demand.

.7 Boiler and/or chiller failure.

.8 Cooling tower (and/or industrial fluid cooler) fan failure.

.9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.4 HYDRONIC SYSTEM CAPACITY TEST

.1 Timing: 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 at all times 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 heat exchanger, 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.

.7 Chilled water system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Adding heat from building heating system or

.2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater that OAT. RAT to be at least 23°C.

.2 Test procedures:

.1 Open fully cooling coil control valves.

.2 Set thermostats on associated AHU's for maximum cooling.

.3 Set AHU's for design maximum air flow rates.

.4 Set load or demand limiters on chillers to 100%

.5 After system has stabilized, record chilled water, condenser water, etc., flow rates and supply and return temperatures simultaneously.

1.5 CONDENSER WATER AND HUMIDIFICATION SYSTEMS

.1 In addition to procedures specified above, perform following:

.1 Add chemicals once per week, or as required.

.2 Perform TAB as specified Section 23 05 93.

.3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.

.4 Inject inhibitor into cooling tower sump.

1.6 GLYCOL SYSTEMS

.1 Test to prove concentration will prevent freezing to minus 40°C

.2 Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.7 STEAM SYSTEMS

.1 Performance verification:

.1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.

.2 Verify operation of components of steam system including, but not necessarily limited to:

.1 Steam traps by:

.1 Measuring temperature of condensate return and/or

.2 Using audio-sensing devices.

.3 Use of other approved methods.

.2 Flash tanks.

.3 Thermostatic vents.

.3 Verify performance of condensation units, including:

.1 Pump capacity at design temperature.

.2 Controls.

.4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.

.5 Adjust piping system as required to eliminate water hammer.

.2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

1.8 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 22.

.2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

1.9 LABORATORY GAS SYSTEMS

.1 Refer to Section 01 91 13: Laboratory Services and Equipment.

1.10 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 21.

.2 Verification of controls, detection devices, alarm devices is specified Electrical Divisions.

.3 Demonstrate that fire hose will reach to most remote location regardless of partitions, obstructions, etc.

.4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.11 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.5 Cleanouts: Refer to Section 22 42 01.

.6 Roof drains:

.1 Refer to Section 22 42 01.

.2 Remove caps as required.

1.12 REPORTS

.1 In accordance with Section 01 91 13: Reports, supplemented as specified herein.

1.13 TRAINING

.1 In accordance with Section 01 91 13: Training of O&M Personnel, supplemented as specified herein.

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 American Society for Testing and Materials

.1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.

.3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.4 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.5 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 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 CLEANING HYDRONIC AND STEAM SYSTEMS

.1 Timing

.1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 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 to be 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 to be used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be 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.

.6 Report on Completion of Cleaning

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 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° 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 so as 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 maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38° 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).

.8 Glycol Systems:

.1 In addition to procedures specified above perform procedures specified herein.

.2 Test to prove concentration will prevent freezing to minus 40° C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

.9 Steam Systems: In addition to general requirements as specified above, perform following:

.1 Remove internal components of steam traps until flushing and warm-up have been completed.

.2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.

.3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.

.4 Water hammer: Determine source and eliminate cause.

3.2 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.

.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 over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93.

.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, etc. 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 all 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.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

- .1 ANSI/ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
- .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .4 ANSI/ASME B18.2.1-2010, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.

.2 ASTM International

- .1 ASTM A47/A47M-99(R2009), Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-10, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM B32-08, Specification for Solder Metal.
- .4 ASTM B75M-99(R2011), Specification for Seamless Copper Tube (Metric).

.3 Canadian Standards Association (CSA)

- .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .2 CAN/CSA-B149.1-10, Natural Gas Installation Code.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

.2 Indicate on manufacturers catalogue literature following: valves.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

- .1 NPS 1/2 to 2, screwed.
- .2 NPS2 1/2 and over, plain end.

.2 Copper tube: to ASTM B75M.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Soldered: to ASTM B32-08, tin antimony.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

- .1 Malleable iron: screwed, banded, Class 150.
- .2 Steel pipe flanges and flanged fittings: to ANSI/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 ANSI/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 ANSI/ASME B16.18.
- .2 Wrought copper fittings: to ANSI/ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug type.

2.5 GAS CHECK METER

.1 Meter shall be complete with pulse capable reader for tie in to the buildings digital master metering sation. Unit shall be complete with functional manual reader register, temperature compensated and shall read in cubic meters. Battery register type meters will not be accepted.

Part 3 EXECUTION

3.1 PIPING

.1 Install in accordance with Section 23 05 01, supplemented as specified herein.

.2 Install in accordance with applicable Provincial/Territorial Codes.

.3 Install in accordance with CAN/CSA B149.1.

.4 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.2 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.3 FIELD QUALITY CONTROL

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

3.4 PURGING

.1 Purge after pressure test in accordance with CAN/CSA B149.1.

3.5 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.

3.6 CLEANING AND START-UP

.1 In accordance with Section 23 08 02, supplemented as specified herein.

.2 In accordance with requirements of CAN/CSA B149.1, supplemented as specified herein.

3.7 PERFORMANCE VERIFICATION (P.V.)

.1 Refer to Section 23 08 01.

.2 Follow Commissioning requirements listed in Section 01 91 13.

END OF SECTION

Part 1 GENERAL

1.1 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 ½ 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. Loaded 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.
- .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.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-67-2002a, Butterfly Valves.
- .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
- .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic system components and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Components and accessories.

.2 Dimensions

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

.1 Include special servicing requirements.

1.4 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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic system components 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 and packaging materials in accordance with Section 01 74 20.

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.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Roll grooved: standard coupling to CSA B242.

.4 Flanges: plain 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 and ASME B18.2.2.

.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 and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M ductile iron to ASTM A536.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where hydronic systems are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05.

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 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.4 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02.

3.5 BALANCING

.1 Balance water systems to within plus or minus 5% of design output.

.2 In accordance with Section 23 05 93 for applicable procedures.

3.6 GLYCOL CHARGING

.1 Include mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.

.3 Submit copies of final shop drawings operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical steel pressurized diaphragm type expansion tank.

.2 Capacity: as indicated on drawings.

.3 Size: as indicated on drawings.

.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

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 620 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

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: NPS 1 ½ 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 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.8 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast iron body to ASTM A278/A278M, Class 30 flanged connections.

.3 NPS 2 to 12: T type with malleable iron body to ASTM A47M, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel with 1.19 mm perforations.

.6 Working pressure: 860 kPa.

2.9 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.

2.10 PACKAGED GLYCOL FEED SYSTEM

.1 Provide a packaged, pre-piped glycol feed system for automatic addition of glycol. The system automatically maintains pressure in the loop by adding glycol solution to make up for losses. Glycol addition is controlled by a pressure switch with adjustable low and high set points.

.2 The packaged system shall include:

.1 A polyethylene tank mounted on a steel frame.

.2 Pump shall be bronze rotary gear type

.3 Float switch for low level pump shufoff and alarm.

.4 NEMA 4X control panel

.1 Hand-Off-Auto

.2 Pump “on” indicator light

.3 Dry contact for remote low level indication to BAS

.4 Power Cord with Plug, 120V.

.5 Provide audible alarm and push button silence.

2.11 GLYCOL SUPPLY

.1 Provide only premixed glycol solution to scheduled propylene glycol concentration, glycol solution shall be a minimum of 40% concentration.

.2 Provide sufficient quantity to fill the entire system.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for hydronic specialties installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where hydronic specialties are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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.

.4 Install ahead of each automatic control valve larger than NPS 1and as indicated.

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 service sink.

3.6 EXPANSION TANKS

.1 Adjust expansion tank pressure as indicated.

.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 50mm diameter.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment

.2 Include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Indicate electrical characteristics including voltage, phase, and current draw

.3 Shop Drawings:

.1 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.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

.3 Submit copies of final pump shop drawings, installation manuals, and operation manuals for inclusion in the operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic pumps 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 and packaging materials as specified Section 01 74 20.

Part 2 PRODUCTS

2.1 EQUIPMENT

.1 Size and select components to: CAN/CSA-B214.

2.2 IN-LINE CIRCULATORS

.1 The pumps shall be a wet rotor inline pump, in cast iron or lead free bronze body construction specifically designed for quiet operation. Suitable standard operations at 230° F and 175 PSIG working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.

.2 The pump internals shall be capable of being serviced without disturbing piping connections.

.3 Pump shall be equipped with a water-tight seal to prevent leakage.

.4 Pump volute shall be of a cast iron design for heating systems or lead free bronze for domestic water systems. The connection style on the cast iron and bronze pumps shall be flanged.

.5 Motor shall be a synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.

.6 Each motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.

.7 Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).

.8 Pump shall have BACnet connections built into the VFD as standard options.

.9 Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.

.10 Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.

.11 Pumps shall be UL 778 listed and bear the UL Listing Mark for USA and Canada with on-board thermal overload protection.

.12 Each pump shall be factory performance tested before shipment.

2.3 VERTICAL IN-LINE CIRCULATORS (P-PHC1, P-HC1, P-CC1)

.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: brass or bronze.

.3 Shaft: 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: refer to motor specification, motor to be rated for VFD operation.

.7 Capacity: as indicated.

.8 Design pressure: as indicated.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions on site are acceptable for hydronic pump 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.

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 Pipe drain tapping to floor drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13: General Requirements; supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours 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 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.

.3 Where procedures do not exist, discontinue PV, report to Departmental Representative 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 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: 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.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)

- .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
- .2 ASME B16.25-07, Buttwelding Ends.
- .3 ASME B16.3-11, Malleable Iron Threaded Fittings: Classes 150 and 300.
- .4 ANSI/ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
- .5 ANSI/ASME B16.9-07, Factory-Made Wrought Steel Buttwelding Fittings.
- .6 ASME B18.2.1-2010), Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
- .7 ASME B18.2.2-2010, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)

- .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.3 ASTM International Inc.

- .1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM A126-04(2014), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.4 Canadian Standards Association (CSA International)

- .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

- .1 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .2 MSS-SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .3 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
- .4 MSS-SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 20.

1.5 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Stock Materials:

.1 Provide spare parts as follows:

.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: 2 of each size.

.5 Gaskets for flanges: one for every ten flanges.

Part 2 PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 Steam;

.1 To NPS 6: Steel Schedule 80, Seamless or ERW

.2 Condensate;

.1 Steel, Schedule 80, Seamless or ERW

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.

.4 Pipe thread: taper.

.5 Bolts and nuts: carbon steel, to [NSI/ASME B18.2.1 and ANSI/ASME B18.2.2.

.6 Buttwelding ends: to ANSI/ASME B16.25.

2.3 FITTINGS

.1 Pipe flanges: cast-iron to ASME B16.1, Class 125.

.2 Screwed fittings: malleable iron to ASME B16.3, Class 150.

.3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.

.4 Buttwelding fittings: steel to ANSI/ASME B16.9.

.5 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

2.4 VALVES

.1 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2 1/2 and larger:

.1 Equipment: Flanged ends.

.2 Elsewhere: Flanged ends.

.2 Gate valves: Application: Steam service, for isolating equipment, control valves, gravity condensate return service, steam drip point assemblies.

.1 Gate Valves up to 40 mm: Bronze body, inside screw, traveling stem, solid wedge, screw-in bonnet, threaded ends rating 860 kPa steam.

.2 Gate Valves 50 mm and Over: Cast iron body, flanged ends, O.S. and Y, rising stem, bronze trim, solid wedge, rating 860 kPa steam

.3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.

.1 Globe Valves up to 40 mm: Bronze body, screw over bonnet, threaded ends, rating 1035 kPa steam.

.2 Globe Valves 50 mm and Over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disc. Rating 860 kPa steam.

.4 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01.

.5 Lift check valves:

.1 NPS 2 and under: Class 125, lift, with composition disc, as specified Section 23 05 23.01.

.2 NPS 2 1/2 and over: as specified Section 23 05 23.01.

2.5 VALVE OPERATORS

.1 Provide suitable handwheel operators for valves.

.2 Provide gear operators for valves 250 mm and over.

.3 Provide valves larger than 100 mm located more than 2.1 m from floor, in equipment rooms, with chain operated sheaves. Extend chains to 1.5 m above floor, and hook to clips to clear walking aisles.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 PIPING

.1 Install pipework in accordance with Section 23 05 01, and supplemented as specified below.

.2 Connect branch lines into top of mains.

.3 Install piping in direction of flow with slopes as follows, unless indicated:

.1 Steam: 1:240.

.2 Condensate return: 1:70.

.4 Make provision for thermal expansion as indicated.

.5 Drip pocket: line size.

3.3 VALVES

.1 Install valves at an accessible height (maximum 1200 mm above finished floor) wherever possible.

3.4 TESTING

.1 Test system in accordance with Section 21 05 01.

.2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.5 SYSTEM START-UP

.1 In accordance with Section 23 08 02.

3.6 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 23 08 01and supplemented as specified herein.

.2 Timing, only after:

.1 Pressure tests successfully completed.

.2 Flushing as specified has been completed.

.3 Water treatment system has been commissioned.

.3 PV Procedures:

.1 Verify complete drainage of condensate from steam coils.

.2 Verify proper operation of system components, including, but not limited to:

.1 Steam traps - verify no blow-by.

.2 Flash tanks.

.3 Thermostatic vents.

.4 Humidifiers: for commissioning procedures, refer to Section 23 84 13.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society for Mechanical Engineers (ASME International)

.2 ASTM International Inc.

.1 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.3 ASTM A216/A216M-08, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.

.4 ASTM A240/A240M-10a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.5 ASTM A276-10, Standard Specification for Stainless Steel Bars and Shapes.

.6 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure - Containing Parts for Temperatures up to 650 Degrees F (350 degrees C).

.7 ASTM A351/A351M-10, Standard Specification for Castings, Austenitic, for Pressure- Containing Parts.

.8 ASTM A564/A564M-10, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.

.9 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

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

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature Canadian Registration Number (CRN), and datasheets for steam traps, vacuum breakers, pressure reducing valves, air vents, safety relief valves, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 and include following:

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.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, paddling, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Cast steel: to ASTM A216/A216M.

.2 Cast iron: to ASTM A278, Class 300.

.3 Bronze: to ASTM B62.

.4 Stainless steel: to ASTM A351/A351M.

2.2 INVERTED BUCKET STEAM TRAP 0-1000 KPA

.1 Application: for non-modulating steam services on humidifiers.

.2 Cast iron body and cap. Stainless steel bucket, seat, head, operating mechanism and strainer. Integral vacuum breaker. Service pressure rating: 1035 kPa steam, temperature rating 230°C

2.3 VACUUM BREAKERS 2.10-68 KPA

.1 Application: on inlets to steam coils, heat exchangers and as indicated.

.2 Materials: body and cap - lead-free brass; spring - stainless steel; stem and seat - lead-free brass.

.3 Capacity: as indicated.

2.4 PRESSURE REDUCING VALVE

.1 Location: as indicated.

.2 Type: as indicated

.3 Internally piloted pressure reducing valves: Internally piloted, piston operated pressure reducing valve, incorporating two valves. A pilot and a main valve to be contained within one unit. Valve to be cast iron, with field adjustable screw to achieve desired set pressure, operating with a flat diaphragm and stainless steel valves and seats. Piston and cylinder shall be made of bronze. Valve to be self-contained and does not require an external sensing line.

.4 Direct-acting pressure reducing valves: Valve to be cast iron, with field adjustable screw to achieve desired set pressure, operating with a flat diaphragm and stainless steel valve and set. Valve to be self-contained and does not require an external sensing line.

.5 Connections:

.1 Under NPS 2: screwed ends.

.6 Capacity:

.1 As indicated.

2.5 SAFETY AND RELIEF VALVES

.1 Spring loaded type of bronze with high capacity and full nozzle and to ASME code.

.2 Material: body forged copper alloy; valve - housing cast bronze; spring – stainless steel; lead-free bronze/brass trim.

.3 Capacity: as indicated

2.6 DRIP PAN ELBOWS

.1 Application: on discharge of steam safety relief valves as indicated.

.2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.

2.7 PIPE LINE STRAINERS

.1 Application: ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.

.2 Working pressure: 860 kPa.

.3 Size to 40 mm: 1720 kPa rating, screwed, cast iron casting, Y-pattern sediment separator with 0.8 mm 304 stainless steel screen. Connections: screwed.

.4 Size 50 mm and Over: 1720 kPa flanges, cast iron, Y-pattern, sediment separator with 1.6 mm 304 stainless steel screen

2.8 DRAIN COOLER

.1 Locations: at condensate discharge points of humidifiers and steam traps.

.2 Tanks: vertical type with threaded drop tube connections.

.3 Sizes: 330 mm height x 279 mm diameter, 6.8 kg weight.

.4 Body constructed of ASTM A48 cast iron, fittings constructed of malleable iron, body constructed of brass, sensing bulb constructed of bronze.

.5 Flow rate of total condensate and cooling water combined: 19 lpm

.6 Construction: to ASME code.

.7 Maximum working pressure: 860 kPa.

.8 Connections: NPS 2 and under, screwed.

.9 Finish: prime coated.

.10 Supports: vertical legs for vertical tank; saddles for horizontal tank.

Part 3 EXECUTION

3.1 APPLICATION

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

.2 Maintain proper clearance around equipment to permit maintenance.

3.2 STRAINERS

.1 Install as indicated.

.2 Ensure clearance for removal of basket.

.3 Install valved blow-down as indicated.

3.3 SAFETY RELIEF VALVE

.1 Pipe to atmosphere independent of other vents and in accordance with applicable code.

.2 Support discharge pipe against reaction forces and to take up thermal movement.

.3 Drain pipe from drip pan elbow to terminate over floor drain.

3.4 STEAM TRAPS

.1 Install unions on inlet and outlet.

3.5 PRESSURE REDUCING VALVES

.1 Install on 3-valve bypass with strainer on inlet.

.2 Pipe as indicated. Follow manufacturer's installation instructions.

3.6 FLASH TANKS

.1 Pipe arrangement as indicated.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01.

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASME

.1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.

.3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.

.2 ASTM International

.1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.

.2 ASTM B280-13, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 CSA Group

.1 CSA B52-13, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 1 copy of WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

.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.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping for incorporation into manual.

.3 Submit copies of operation and maintenance information for inclusion in manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect refrigerant piping, fittings and equipment 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 and packaging materials as specified in Section 01 74 20.

Part 2 PRODUCTS

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B280, type ACR.

.2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121 degrees C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 15% Ag-80% Cu-5%P and non-corrosive flux.

.3 Flanged:

.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.

.2 Gaskets: suitable for service.

.3 Bolts, nuts and washers: to ASTM A307, heavy series.

.4 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for refrigerant piping installation in accordance with manufacturer's written instructions.

.1 Visually inspect area of installation.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05.

3.4 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.5 PIPING INSTALLATION

.1 General:

.1 Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified.

.2 Small riser: size for 5.1 m^3 /s at minimum load. Connect upstream of traps on large riser.

.5 Provide sufficient refrigerant charge as required.

3.6 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.

.3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.7 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa absolute and hold for 4 hours.

.2 Break vacuum with refrigerant to 14 kPa.

.3 Final to 5 Pa absolute and hold for at least 12 hours.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Submit test results to Departmental Representative.

.7 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:

.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Record and report measurements to Departmental Representative.

.9 Manufacturer's Field Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.1 Upon completion of the Work, after cleaning is carried out.

.3 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.8 DEMONSTRATION

.1 Instructions:

.1 Post instructions in frame with glass cover in accordance with Section 01 78 00 and CSA B52.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.

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

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit copies of WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for HVAC water treatment systems for incorporation into manual.

.3 Include following:

.1 Log sheets as recommended by Departmental Representative.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 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.

.2 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the owner.

.3 Materials which may contact finished areas shall be colorless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.

.4 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.

.5 Closed System Treatment: Sequestering agent to reduce deposits and adjust PH, and a corrosion inhibitor.

.6 Steam System Treatment: Provide an oxygen scavenging agent, corrosion inhibitor, alkalinity control compound, sequestering agent to reduce hardness, and carbon dioxide neutralizer. Chemicals used in steam humidification boilers must be non toxic and must not boil-off with steam.

.7 Cooling Tower Treatment: Non-acid, non-polluting, non-chromate, non-phosphate, corrosion and scale inhibitor. For slime control add micro-biostats and algaecides (once or twice a week as required).

2.2 EQUIPMENT

.1 Solution Pumps: Provide positive displacement diaphragm type metering pumps for adding chemicals. Pumps shall have an adjustable flow rate and be suitable for chemicals to be pumped. Pumps shall be self flushing. Provide pumps with plastic solution tanks complete with agitator, pump mounting, cover, provision for fill line and pump strainer. Size the pumps and tanks to permit operation for three days at 50% pump capacity without refill of tanks. Provide agitator motor with terminals and junction box for electric wiring.

.2 Provide chemical pot feeder with a minimum of 10 L capacity, semi-sphere top and bottom, one pot feeder per system, located as shown on system schematics and floor plans. If location is in question obtain clarification from the Consultant prior to installation.

.3 Chemical Pot Feeder

.1 Welded steel. Temperature rating: 90°C.

.2 One feeder per closed water loop. Welded steel.

.3 Pressure rating: 2068 kPa. Temperature rating: 90°C.

.4 In/ out connections shall be 20mm FNPT.

.4 Water Treatment For Hydronic Systems

.1 Chemical Pot Feeder:

.1 Provide one 7.6L by-pass pot feeder for each closed water loop system for the addition of the corrosion inhibitor. Each feeder shall be welded steel and have a maximum pressure of 300 psi and a maximum temperature of 200°F. In/out connections shall be ¾" FNPTHot.

.2 Bypass Filter Housing:

.1 Provide one by-pass filter housing for each closed water loop system to provide sidestream filtration. Each housing shall be welded steel and have a maximum pressure of 250 psi and a maximum temperature of 250°F. In/out connections shall be ¾" FNPT. It shall house 1 x 20" filter cartridges and have a maximum flowrate of 0.9L/S.

.2 Provide startup quantity (enough for at least 5 changes per filter housing) of twenty inch long cotton filters with stainless steel core rated at 25 microns.

.3 Make-Up Water Flow Meter:

.1 Provide one water meter for each closed water loop system to measure and monitor the flow of make-up water. The meter shall be manufactured from cast bronze and have both a totalizing register and a 10 gpc contacting head. The meter shall have ¾" NPT male connections and be capable of 1L/S continuous flow with an accuracy of +/- 1.5%. The meter shall be able to withstand a maximum operating pressure of 1034Kpa. Water meter shall be manufactured by Jesco.

.4 Four Port Corrosion Coupon Rack – Steel:

.1 Provide one 4 port condensate corrosion coupon rack shall be provided for each closed water loop system for possible future corrosion study use. Each rack is designed to monitor the effectiveness of the water management program. The rack shall be constructed of black steel piping with 4 carbon steel/teflon coupon holders. It shall have a maximum pressure of 1034Kpa and a maximum fluid temperature of 121°C. In/out pipe size shall be 25mm.

.5 Closed Glycol Loop Treatment Equipment

.1 Automatic Glycol Feed System:

.1 Refer to section 23 21 14.

.2 Bypass Filter Housing:

.1 Provide one by-pass filter housing for each closed water loop system to provide sidestream filtration. Each housing shall be welded steel and have a maximum pressure of 250 psi and a maximum temperature of 250°F. In/out connections shall be ¾" FNPT. It shall house 1 x 20" filter cartridges and have a maximum flowrate of 0.9L/S.

.2 Provide startup quantity (enough for at least 5 changes per filter housing) of twenty inch long cotton filters with stainless steel core rated at 25 microns.

.6 Chemicals

.1 Provide 1 years supply.

.7 Test Equipment

.1 One wall mountable test cabinet with light shall be provided. The cabinet shall come complete with all required equipment and reagents for performing water tests for hardness, alkalinity, molybdate, and nitrite. It shall include an electronic conductivity & pH meter, a glycol refractometer and all associated glassware for performance of on-site water tests.

.8 Water Softeners for Humidifiers

.1 Floor mounted water softener and brine tank.

.2 Automatic metering heads to regenerate softener media automatically

.3 Softener unit to be complete with keypad/display

.4 Provide one softener to treat water for both AHU-3 and AHU-5 humidifiers

.1 Capacity to be 47.2 kg/hr (104 lbs/hr)

.2 Water hardness of 8 grains

.5 Provide water softener to treat water for AHU-1 humidifier

.1 Capacity to be 266.7 kg/hr (580 lbs/hr)

.2 Water hardness of 8 grains

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC water treatment systems 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 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 HVAC water treatment systems in accordance with ASME Boiler and Pressure Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.4 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.5 CLEANING OF MECHANICAL SYSTEM

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 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.

.2 Once process is complete, Chemical treatment representative shall provide a letter certifying that systems have been properly cleaned and passivated.

.3 Provide temporary piping connection, by-passes and strainers as required for introduction of cleaning chemicals and removal of debris.

.5 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.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 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 Provide an adequate quantity chemicals to thoroughly clean all new piping and associated equipment by removing sludge, oil, dirt and debris. Utilize multi-component phosphate based cleaner and a bio-dispersant. These products shall be used for cleaning and flushing of all new water systems (excluding domestic water). Cleaning and flushing procedure shall be as per manufacturer’s instructions.

.5 Provide temporary piping connection, by-passes and strainers as required for introduction of cleaning chemicals and removal of debris.

.6 Closed loop systems: circulate system cleaner at 60 degrees C for at least 72 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.7 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.

.8 Add chemical solution to system.

.9 Establish circulation, raise temperature slowly to maximum design. 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).

.8 Glycol Systems:

.1 In addition to procedures specified above perform specified procedures.

.2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

.9 Steam Systems: in addition to general requirements as specified above, perform following:

.1 Remove internal components of steam traps until flushing and warm-up have been completed.

.2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.

.3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.

.4 Water hammer: determine source and eliminate cause.

.10 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils and boilers shall be done prior to final fill and chemical treatment.

3.6 DOMESTIC WATER

.1 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre (50 ppm) and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 milligrams per litre (20 ppm). If less than 20 milligrams per litre (20 ppm) repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav, sinks, flushometers, and similar criteria.) for drainage.

3.7 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of 1 year after system start-up. Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start-up assistance.

.3 Operating staff training.

.4 Visit plant every 60 days during period of operation and as required until system stabilizes, and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for 1 year operation.

.6 Provide necessary laboratory and technical assistance.

.7 Provide clear, concise, written instructions and advice to operating staff.

3.8 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.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.2 ASTM International

.1 ASTM A480/A480M-13b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-13, 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-13, 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-15, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Test and Evaluation Reports:

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified Section 01 35 21.

Part 2 PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	B

.2 Seal classification:

.1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 SEALANT

.1 Low VOC Characteristics:

.1 Adhesives and sealants: in accordance with Section 07 92 00.

.2 Adhesives and sealants: VOC limit to GS-36.

.2 Sealant: synthetic latex emulsion water based type with a service temperature of -17°C to 105°C.

2.3 DUCT LEAKAGE

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

2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius with centreline radius: 1.5 times width of duct.

.2 Round: smooth radius with, centreline radius: 1.5 times diameter of duct.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct.

.2 Round main and branch: enter main duct at 45 degrees [with conical connection].

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Short radiused elbows, or as indicated on drawings.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.5 FIRE STOPPING

.1 Provide 50 mm x 50 mm x 3 mm retaining angles ready for and firestops and smokeseals.

.2 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00.

.3 Fire stopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

.1 Steel Sheet: Tension levelled, Forming Steel (FS) designation, Type A, Grade 230 in accordance with ASTM A653/A653M.

.2 Thickness: Minimum base metal thickness as noted for specific configuration or thicker as required to meet design loads.

.3 Galvanizing Designation: Z350 applied evenly to both sides.

.4 Thickness, Fabrication and Reinforcement: to SMACNA requirements.

.5 Joints: to meet SMACNA requirements.

.6 Finish in exposed areas shall be ready for painting, ductwork to match ceiling finish. Refer to floor plans for extent of ductwork to be exposed.

2.7 STAINLESS STEEL

.1 Type: 316 meeting the requirements of ASTM A167.

.2 Finish: ready for painting, ductwork to match ceiling finish.

.3 Thickness, Fabrication and Reinforcement: to SMACNA requirements.

.4 Joints: to meet welded SMACNA requirements.

2.8 PRE-MANUFACTURED FLEXIBLE DUCTS:

.1 Low Pressure:

.1 Location: Use flexible air duct where shown on Drawings.

.2 Length: Not greater than 600 mm.

.3 Composition: CPE liner banded to steel wire helix, wrapped with fibreglass insulation and outer fibreglass reinforced metalized vapour barrier jacket.

.4 Velocity Rating: Flexible duct rated for 12 m/s velocity and pressure rated for 500 Pa positive and 500 Pa negative.

.2 Medium and High Pressure:

.1 Location: Use flexible air duct to connect terminal units to metal ductwork.

.2 Length: Not greater than 300 mm.

.3 Composition: Woven and vinyl coated fibreglass liner bonded to a steel wire helix; furnish flexible air duct with fibreglass insulation and outer fibreglass reinforced metalized vapour barrier jacket where flexible air duct is attached to metal insulated duct.

.4 Velocity Rating: Flexible duct rated for 30 m/s velocity and pressure rated for 4.0 kPa positive and 500 Pa negative.

2.9 FASTENERS

.1 Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts; weld fume hood exhaust ducts.

2.10 BUILT-UP PLENUMS

.1 Fabricate plenums and casings to configurations shown on Drawings.

.2 Construct plenums of galvanized panels joined by standing seams on outside of casing riveted or bolted on approximately 300 mm centres.

.3 For central fume hood exhaust system the plenum construction shall match duct material.

.4 Reinforce with suitable angles and provide diagonal bracing as required. Tightly fit at apparatus and caulk with sealant.

.5 Reinforce door frames with steel angle tied to horizontal and vertical plenum supporting angles; install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

.6 Fabricated acoustic plenums of galvanized steel from 1.519 mm back facing and 0.759 mm perforated front facing with 2.5 mm diameter holes on 5 mm centres; construct panels 75 mm thick packed with nominal 72 kg/m^3 glass fibre acoustical insulation.

.7 Provide necessary baffling in mixed air plenums to ensure good mixed air temperature with variations of not more than ±3°C under all operating conditions.

.8 Fabricate fan plenums and plenums downstream of fan to match thickness of ducts.

.9 Fabricate plenums between fan and upstream apparatus using 1.519 mm material.

.10 Fabricate plenums between filters and upstream apparatus using 1.214 mm thick material.

2.11 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions are acceptable for metal duct installation in accordance with manufacturer's written instructions.

.1 Visually inspect elements to which ductwork hangers will be attached.

.2 Visually inspect elements which will be penetrated by ductwork.

.3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied.

3.2 GENERAL

.1 Do work in accordance with NFPA 90A, SMACNA, and drawings as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with SMACNA as indicated.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 Where acoustic duct lining is noted, ductwork sizing stated on drawings represents clear inside dimensions.

3.3 CONSTRUCTION

.1 Construct ductwork from site measurements and not from plans and shop drawings exclusively; failure to do so will not constitute an extra to the Contract.

.2 Complete metal ducts within themselves with no single partition between ducts; cross brace ducts for rigidity where width of duct exceeds 450 mm; open corners are not acceptable.

.3 Lap metal ducts in direction of air flow; hammer down edges and slips to leave interior of duct smooth.

.4 Construct ductwork using materials in thicknesses indicated; reinforced and sealed for pressure class indicated, and as follows:

.1 Increase duct size gradually, not exceeding 15° divergence wherever possible; do not exceed 30° divergence upstream of equipment; do not exceed 45° convergence downstream of equipment.

.2 Construct tees, bends and elbows with radius of not less than 1.5 times the width of duct on centreline; provide double wall air foil type turning vanes where turning radius is not possible and where rectangular elbows are specified; provide turning vanes of perforated metal type with fibreglass inside, where acoustical lining is provided.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag; caulk duct joints and connections using sealant as ducts are being assembled; seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.

.6 Weld stainless steel ductwork and ensure a smooth finish on all interiors.

.7 Fabricate continuously welded round and oval duct fittings two gauge thicknesses heavier than duct gauges indicated in SMACNA Standard.

.8 Set plenum doors 150 mm above floor; arrange door swings so that fan static holds door in closed position.

.9 All supply and return ductwork shall be galvanized as per section 2.

.10 All fume hood exhaust ductwork shall be 316 stainless steel continuously welded as per section 2. Horizontal runs shall be sloped at minimum 2.5 cm per 3 meters downward in the direction towards the shaft where a drip point complete with drain valve shall be provided.

3.4 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, or as follows, whichever is more stringent:

Duct Size (mm)	Spacing (mm)

to 1500	3000
1501 and over	2500

3.5 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Minimum 3000 mm from duct mounted humidifier in all directions.

.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Weld joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards fume hoods served.

.1 Slope header ducts down toward risers.

.4 Fit base of riser with drain pan and 32 mm drain connected, with deep seal trap discharging to open funnel drain or as indicated on drawings.

3.6 DUCT SEALING

.1 Seal all supply, return and exhaust duct joints, longitudinal as well as transverse, using the following:

.1 Low Pressure Ductwork:

.1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.519 mm use heavy mastic type sealant.

.2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

.3 Other Joints: Heavy mastic type sealant.

.2 Medium and High Pressure Ductwork: Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Consultant.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

.6 All existing ductwork to remain shall be sealed with sprayable water based duct sealant. Sealant shall be indoor grade, listed for up to 15”w.g., flame and smoke development shall be 0/5.

.1 Sealant shall be a synthetic latex emulsion water based type with a service temperature from 0F to 220F.

.2 Standard of acceptance: ProSeal Spray by Ductmate Industries Inc.

.3 Contractor to carryout video scope of existing ductwork prior to duct sealant being applied and following the duct sealant being applied to assure the duct has been fully sealed.

.4 Pressure test of ductwork existing ductwork shall be carried out prior to making connections to new distribution system.

3.7 LEAKAGE TESTS

.1 Refer to Section 23 05 94.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial test has been passed.

.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete test before performance insulation or concealment Work.

3.8 INSTALLATION

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors as specified in Section 23 33 00.

.3 Provide openings in ductwork where required to accommodate thermometers and controllers.

.4 Provide pitot tube openings where required for testing of systems, including metal cap with spring device or screw to prevent air leakage; install insulation material inside a metal ring where openings are provided in insulated ductwork.

.5 Interrupt duct linings at fire, balancing, backdraft and smoke dampers so as not to interfere with operation of devices; provide sheet metal edge protection over linings on both side of damper device.

.6 Shield ductwork from dust and construction material during construction; clean any ductwork found to be dirty at no extra cost to the Contract.

.7 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment, refer to Section 23 33 00.

.8 Do not use flexible duct to change direction.

.9 Provide a minimum of three (3) duct diameters of straight metal duct between box inlet and flexible connector.

.10 Connect diffusers or troffer boots to low pressure ducts with 300 mm maximum stretched length of flexible duct; hold in place with sealant, and strap or clamp.

.11 Prove that ductwork is substantially air tight before covering or concealing.

.12 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.2 ASTM International

.1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).

.3 Green Seal Environmental Standards (GS)

.1 GS-36-11, Standard for Adhesives for Commercial Use.

.4 Sheet Metal 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 SMACNA IAQ Guideline for Occupied Buildings Under Construction, 2007.

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Test and Evaluation Reports:

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GALVANIZED STEEL

.1 Steel Sheet: Tension levelled, Forming Steel (FS) designation, Type A, Grade 230 in accordance with ASTM A653/A653M.

.2 Thickness: Minimum base metal thickness as noted for specific configuration or thicker as required to meet design loads.

.3 Galvanizing Designation: Z350 applied evenly to both sides.

.4 Thickness, Fabrication and Reinforcement: to SMACNA requirements.

.5 Joints: to meet SMACNA requirements.

.6 Finish in exposed areas shall be ready for painting, ductwork to match ceiling finish. Refer to floor plans for extent of ductwork to be exposed.

2.2 STAINLESS STEEL

.1 Type: 316 meeting the requirements of ASTM A167.

.2 Finish: ready for painting, ductwork to match ceiling finish.

.3 Thickness, Fabrication and Reinforcement: to SMACNA requirements.

.4 Joints: to meet welded SMACNA requirements.

2.3 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	A
1500	A
1000	A
750	B

.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 gaskets, sealant, tape or combination thereof.

2.4 SEALANT

.1 Sustainability Characteristics:

.1 Adhesives and sealants: in accordance with Section 07 92 00.

.2 Adhesives and sealants: VOC limit to GS-36.

.2 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.

.1 Temperature range of minus 30 degrees C to plus 93 degrees C.

2.5 TAPE

.1 Tape: polyvinyl treated, open weave fibre glass, 50 mm wide.

2.6 BUILT-UP PLENUMS

.1 Fabricate plenums and casings to configurations shown on Drawings.

.2 Construct plenums of galvanized panels joined by standing seams on outside of casing riveted or bolted on approximately 300 mm centres.

.3 For central fume hood exhaust system the plenum construction shall match duct material.

.4 Reinforce with suitable angles and provide diagonal bracing as required. Tightly fit at apparatus and caulk with sealant.

.5 Reinforce door frames with steel angle tied to horizontal and vertical plenum supporting angles; install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

.6 Fabricated acoustic plenums of galvanized steel from 1.519 mm back facing and 0.759 mm perforated front facing with 2.5 mm diameter holes on 5 mm centres; construct panels 75 mm thick packed with nominal 72 kg/m³ glass fibre acoustical insulation.

.7 Provide necessary baffling in mixed air plenums to ensure good mixed air temperature with variations of not more than ±3°C under all operating conditions.

.8 Fabricate fan plenums and plenums downstream of fan to match thickness of ducts.

.9 Fabricate plenums between fan and upstream apparatus using 1.519 mm material.

.10 Fabricate plenums between filters and upstream apparatus using 1.214 mm thick material.

2.7 HANGERS AND SUPPORTS

.1 Hangers and supports: in accordance with Section 23 05 29.

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA or the following table, whichever is more stringent.

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp or steel plate washer.

.3 For steel beams: manufactured beam clamps.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for metal duct installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate area where ductwork is to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied

3.2 GENERAL

.1 Do work in accordance with NFPA 90A, SMACNA, and drawings as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate band hangers 100 mm beyond insulated duct.

.2 Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

3.3 HANGERS

.1 Band hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: SMACNA or as follows, whichever is more stringent:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.4 CONSTRUCTION

.1 Construct ductwork from site measurements and not from plans and shop drawings exclusively; failure to do so will not constitute an extra to the Contract.

.2 Complete metal ducts within themselves with no single partition between ducts; cross brace ducts for rigidity where width of duct exceeds 450 mm; open corners are not acceptable.

.3 Lap metal ducts in direction of air flow; hammer down edges and slips to leave interior of duct smooth.

.4 Construct ductwork using materials in thicknesses indicated; reinforced and sealed for pressure class indicated, and as follows:

.1 Increase duct size gradually, not exceeding 15° divergence wherever possible; do not exceed 30° divergence upstream of equipment; do not exceed 45° convergence downstream of equipment.

.2 Construct tees, bends and elbows with radius of not less than 1.5 times the width of duct on centreline; provide double wall air foil type turning vanes where turning radius is not possible and where rectangular elbows are specified; provide turning vanes of perforated metal type with fibreglass inside, where acoustical lining is provided.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag; caulk duct joints and connections using sealant as ducts are being assembled; seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.

.6 Weld stainless steel ductwork and ensure a smooth finish on all interiors.

.7 Fabricate continuously welded round and oval duct fittings two gauge thicknesses heavier than duct gauges indicated in SMACNA Standard.

.8 Set plenum doors 150 mm above floor; arrange door swings so that fan static holds door in closed position.

.9 All supply and return ductwork shall be galvanized as per section 2.

.10 All fume hood exhaust ductwork shall be 316 stainless steel continuously welded as per section 2. Horizontal runs shall be sloped at minimum 2.5 cm per 3 meters downward in the direction towards the shaft where a drip point complete with drain valve shall be provided.

3.5 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA guidelines.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.6 LEAKAGE TESTS

.1 Refer to Section 23 05 94.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Perform leakage tests in sections.

.4 Perform trial leakage tests, as instructed to demonstrate quality of work.

.5 Do not install additional ductwork until trial tests have been achieved.

.6 Test section minimum of 30 m long with not less than 3 branch takeoffs and two 90 degrees elbows.

.7 Complete tests before performing insulation or concealment Work.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect dampers 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Single thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 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 as indicated.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 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: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage: 21 L/s/m^2 at 250 Pa.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect site conditions in area where dampers are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International

.1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect dampers, 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 CONTROL DAMPERS

.1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.

.2 Materials:

.1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.

.2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.

.3 Bearings: maintenance free, synthetic type of material.

.4 Linkage and shafts: aluminum, zinc and nickel plated steel.

.5 Seals: synthetic type, mechanically locked into blade edges.

.1 Frame seals: synthetic type, mechanically locked into frame sides.

.3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.

.1 Size/Capacity: refer to damper schedule

.2 25 L/s/m² maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.

.3 Temperature range: minus 40°C to plus 100°C.

.4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.

.5 Jack shafts:

.1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.

.2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.

.3 Install using manufacturers installation guidelines.

.4 Use same manufacturer as damper sections.

.6 type mounting base to permit continuity of insulation under the mechanism.

2.2 BACK DRAFT DAMPERS

.1 Construct of minimum 0.635 mm aluminum blades, having stiffeners along trailing edge; fabricate single blade dampers for duct sizes less than or equal to 240 mm, multi-blade dampers for ducts greater than 240 mm.

.2 Provide full blade-length shafts complete with brass or nylon bearings.

.3 Provide neoprene anti-clatter blade strips on pivot side of blades.

.4 Construct blade connecting linkage of minimum 2.00 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.5 Maximum blade length of 750 mm.

.6 Backdraft damper suitable for 10 m/s face velocity

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect site conditions in area where dampers are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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.

.5 Ensure dampers are observable and accessible.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate the following:

.1 Fire dampers.

.2 Smoke dampers.

.3 Fire stop flaps.

.4 Operators.

.5 Fusible links.

.6 Design details of break-away joints.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit maintenance materials in accordance with Section 01 78 00.

.2 Provide:

.1 6 fusible links of each type.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect fire and smoke dampers 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 and packaging materials in accordance with Section 1 74 20.

Part 2 PRODUCTS

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B, and bear label of ULC, meet requirements of NFPA 90A and authorities having jurisdiction. 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, square, guillotine type, sized to maintain full duct cross section, for size of duct as indicated on drawings.

.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.

2.2 FIRE STOP FLAPS

.1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.

.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions s are acceptable for fire and smoke damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect the area where the fire and smoke dampers are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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.

.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.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.

.4 Underwriters' Laboratories (UL)

.1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate:

.1 Thermal properties.

.2 Friction loss.

.3 Acoustical loss.

.4 Leakage.

.5 Fire rating.

.3 Test and Evaluation Reports:

.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.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect flexible ducts 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - UNINSULATED

.1 Type 3: non-collapsible, aluminum foil/mylar type, mechanically bonded to, and helically supported by, external steel wire, as indicated.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient:3.

2.3 NON-METALLIC - INSULATED

.1 Type 4: non-collapsible, coated aluminum foil/mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl reinforced mylar/neoprene laminate jacket, as indicated.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

.3 Thermal loss/gain: 1.6 RSI.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for flexible ducts installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where flexible ducts are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110, UL 181, NFPA 90A, and SMACNA.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 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 C1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.5 ASTM G21-13, 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.

.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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for duct liners and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for duct liners for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect duct liners 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 and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DUCT LINER

.1 General:

.1 Mineral Fibre duct liner: air surface coated mat facing.

Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A.

.2 Fungi resistance: to ASTM C1338 and ASTM G21.

.2 Rigid:

.1 Use on flat surfaces where indicated.

.2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.

.3 Density: 48 kg/m^3 minimum.

.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 C 423.

.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 0.74 (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 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 ASTM C916.

.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 fire retardant 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 Verification of Conditions: verify that site conditions are acceptable for duct liner installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where duct insulation is to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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, 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 exceeds 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 Departmental Representative.

.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 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 300-2014, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.5 AMCA Standard 99-0401, Classification for Spark Resistant Construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide:

.1 Fan performance curves showing point of operation, flow rate, kW, static pressure, and efficiency.

.2 Sound rating data at point of operation.

.2 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with variable speed controllers, as appropriate.

.3 Manufacturer name and model number

.4 Electrical voltage, phase, and current draw

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit in accordance with Section 01 78 00.

.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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect HVAC fans from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Section 01 74 20.

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. Supply unit with ANSI/AMCA certified sound rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as indicated on equipment schedules.

.2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan or safety screens as indicated and as specified in Section 23 05 13.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Finish on fume hood exhaust fans: mill.

.6 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.7 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.8 Provide fans capable of accommodating static pressure variations of ± 10% with no objectionable operating characteristics.

.9 Vibration isolation: to Section 23 05 48.

.10 Flexible connections: to Section 23 33 00.

2.3 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Air foil backward inclined blades, as indicated.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.

.3 Shaft seals on laboratory fume hood exhaust fans:

.1 Single disc seals.

.4 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, 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.

.5 Variable volume control devices:

.1 Mounted by fan manufacturer.

.2 Adjustable inlet vanes: operated from a centre mechanism linked to each damper vane. Support each vane at ends in bronze bearings. On DWDI fans interconnect vanes to operate in unison. Provide locking devices for manual operation.

.3 Variable speed drives: refer to Section 23 92 49.

.6 Acid Resistance:

.1 Where indicated on equipment schedules to provide acid resistant fan, fan components to be coated in hi pro polyester coating.

2.4 UTILITY SETS

.1 Characteristics and construction: for centrifugal fans.

.2 Preassemble single width centrifugal fan with removable protective hood with vents, and automatic spring loaded back draft dampers.

.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.5 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct or belt drive, as indicated on the equipment schedules.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.6 LAB EXHAUST FAN (EF-204)

.1 Fan performance data shall follow AMCA Standard Conditions of 0 Ft elevation and 70 Deg F. (Air Density shall be 0.075 lb/ft)

.2 Fans selected shall allow for +/- 15% variation of scheduled static pressure and airflow.

.3 Fan systems shall incorporate integral lifting lugs for ease of installation.

.4 Fan shall be designed to AMCA A spark resistant construction:

.1 Fan housing shall be a minimum 14 gauge steel construction.

.2 Adjustable motor plate, where applicable shall utilize threaded studs for positive belt tensioning.

.3 Fan shall be constructed with an integral housing drain to alleviate rainwater.

.4 Fan shall include a bolted and gasketed access door.

.5 Belt driven fan shafts shall be AISI C-1045 hot rolled or stainless steel and accurately turned, ground, and polished. Shafting shall be sized for a critical speed of at least 125% of maximum fan RPM.

.6 Unit fasteners exposed to corrosive airstream shall be of stainless steel construction.

.7 Unit components fabricated of steel shall be coated with an electrostatically applied, high performance, baked phenolic epoxy powder coating with an ultraviolet protective topcoat. Finish color shall be light gray. Coating thickness shall be 5.0 mils.

.8 Coating shall be salt spray tested per ASTM B117 for in excess of 1000 hours without failure, humidity resistance tested per ASTM D2247 for in excess of 1000 hours without failure, and impact resistance tested per ASTM D2794 and shall pass a minimum of 100 in-lbs.

.9 Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.

.10 Units specified as Spark Resistant Construction shall be constructed to the AMCA Spark Resistant Construction level as dictated on the plans and specifications.

.11 Unit shall be shipped in ISTA Certified Transit Tested Packaging.

.5 Dilution Nozzle

.1 Fans shall incorporate a double concentric accelerator fiberglass reinforced plastic (FRP) induction nozzle selected for optimal performance per the plans and specifications. Nozzle shall be constructed and designed to avoid extreme variations in velocity flows across the outlet, even against wind loading. Where required, CFD shall be provided demonstrating this on submitted nozzle. Bifurcated designs shall not be allowed.

.2 Induction nozzle shall be constructed and designed to efficiently handle up to 7000 feet per minute outlet velocity and shall have a optimally matched accelerator for the specified design conditions.

.3 Design to withstand 125mph winds.

.6 Centrifugal fan Impeller

.1 Fan impeller shall be steel, non-overloading, centrifugal backward inclined, airfoil type. Blades shall be continuously welded to the backplate and inlet shroud.

.2 Fan impeller hub shall be keyed and securely attached to the fan shaft. Fan shaft shall be AISI C-1045 hot rolled or stainless steel and accurately turned, ground, and polished. Shafting shall be sized for a critical speed of at least 125% of maximum fan RPM.

.3 Fan impeller shall be statically and dynamically balanced in accordance with AMCA Standard 204-96, "Balance Quality and Vibration Levels for Fans."

.4 Fan impeller shall be coated with finish to match the fan housing.

.7 Bypass Air Plenum

.1 For variable volume systems a bypass air plenum shall be supplied as shown on the contract drawings.

.2 Bypass air plenum shall introduce outside air above the roof level and shall have rain hood(s) and bird screen protection over the bypass air damper(s).

.3 Bypass air plenum shall be constructed of welded steel, minimum 14 gauge, with a finish to match the fan housing epoxy finish.

.4 Bypass dampers shall be opposed blade design, coated to match the fan housing and plenum.

.5 A fan isolation damper gravity type coated to match fan housing and plenum shall be provided as show on the project documents.

.8 Fan Motors and Drives

.1 Fan motors shall be premium efficiency, NEMA frame, nominal 1800 or 3600 RPM Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.

.2 Belt driven fan drive belts shall be oil and heat resistant, static conducting. Fixed drives shall be sized for a minimum 1.5 service factor (150% of the motor horsepower) and shall be readily and easily accessible for service, if required.

.3 Belt driven fans shall utilize precision machined cast iron type sheaves, keyed and securely attached to the wheel and motor shafts.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions are acceptable for HVAC fan installation in accordance with manufacturer's written instructions.

.1 Visually inspect installation area.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48, flexible electrical leads and flexible connections in accordance with Section 23 33 00.

.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.

.5 Provide vibration isolation as per schedules.

.6 Provide roof curbs and sleepers in accordance with manufacturer recommendation.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 International Organization of Standardization (ISO)

.1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.

.4 Underwriter's Laboratories (UL)

.1 UL 181-2005(R2008), Factory-Made Air Ducts and Air Connectors.

.5 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 130-2008, Methods of Testing Air Terminal Units

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, electrical connection information, finish and limitations.

.3 Shop Drawings:

.1 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

.5 Electrical connection requirements.

.4 Test and Evaluation Reports:

.1 Test data: to procedures documented by ASHRAE 130

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units] for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air terminal units 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 and packaging materials in accordance with Section 01 74 20.

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 certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

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

.2 Supplier of venturi valve to provide all associated controls and sensors for the system to function as described within the scope of work.

2.3 VARIABLE VOLUME TERMINAL BOXES – LABORATORY SYSTEMS

.1 Pressure independent reset to air flow between minimum and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated on drawings.

.3 The airflow control device shall be a venturi valve.

.4 The valve assembly manufacturer’s Quality Management System shall be registered to ISO 9001:2008

.5 Airflow control device shall be tested in accordance with ASHRAE 130.

.6 The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.

.7 The airflow control device shall maintain accuracy within ±5% of signal over an airflow turndown range of no less than:

.1 12.5 to 1 (medium pressure all valve sizes)

.2 16 to 1 (medium pressure w/o 350mm valve)

.3 7 to 1 (low pressure all valve sizes)

.4 11 to 1 (low pressure w/o 350mm valve)

.5 8 to 1 (medium pressure shut-off all valve sizes)

.6 14 to 1 (medium pressure shut-off w/o 350mm valve)

.7 5 to 1 (low pressure shut-off all valve sizes)

.8 9 to 1 (low pressure shut-off w/o 350mm valve)

.8 No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.

.9 No rotational/axial orientation requirements shall be required to ensure accuracy and/or pressure independence.

.10 The airflow control device shall maintain pressure independence regardless of loss of power.

.11 The airflow control device shall be constructed of one of the following types

.1 Class A: The airflow control device for non-corrosive airstreams, such as supply, shall be constructed of 16-gauge aluminum. The device's shaft and internal “S” link shall be made of 316 stainless steel. The shaft support brackets shall be made 316 stainless steel (shutoff valves). The pivot arm shall be 303/304 stainless (for shut off valves). The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a PP (polypropylene) or PPS (polyphenylene sulfide) composite. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.

.2 Class B: The airflow control device for corrosive, or potentially corrosive, airstreams, such as fume hoods, general exhaust, and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal “S” link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of PP (polypropylene) or PPS (polyphenylene sulfide) composite.

.12 Actuation

.1 For electrically actuated VAV operation, a CE certified electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open-maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).

.2 Actuation to be high speed, and response time from 0-90% flow shall be no greater than 1 second.

.13 The controller for the airflow control devices shall be microprocessor based and operate using peer-to-peer control architecture. The room-level airflow control devices shall function as a standalone network, providing feedback to the existing Building Management System

.14 The room-level control network shall utilize a BACnet communications protocol.

.15 There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes.

.16 Terminal devices serving the supply air into L527, L530, L530A and L530B shall be programmed and installed for pressure and temperature control via connection to the dual duct air distribution system.

2.4 EXHAUST AND SUPPLY AIRFLOW DEVICE CONTROLLER

.1 The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.

.2 The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand-alone or to be networked with other room-level digital airflow control devices using an industry standard protocol

.3 Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.

.4 The airflow control device shall use industry standard 24 VAC power.

.5 The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system

.6 The airflow control device shall have built-in integral input/output connections that address fume hood control, temperature control, humidity control occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:

.1 Three universal inputs capable of accepting 0 to 10 VAC, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25 degree C thermistor temperature sensors.

.2 One digital input capable of accepting a dry contact or logic level signal input.

.3 Two analog outputs capable of developing either a 0 to 10 VAC or 4 to 20 mA linear control signal.

.4 One Form C (SPDT) relay output capable of driving up to 1 A @ 24 VAC/VAC.

.7 The airflow control device shall maintain a temperature set point by controlling the airflow from the hot and cold deck supply air or the reheat valve (as applicable) in response to a room temperature sensor.

.8 Provide dual duct temperature control sequence for for all units serving the supply air into L527, L530, L530A and L530B. Two valves shall modulate the hot deck and cold deck to maintain supply air temperature.

2.5 LOCAL TEMPERATURE CONTROL AND DISPLAY UNIT

.1 The control system shall be complete with a view touch screen monitor with 175mm capacitive touch screen and local display that allows control and system variables to be displayed on a user interface terminal device. The Local Display Unit shall connect to the room-level network and provide access to all room-level control data.

.2 The display unit shall be powered by 24 VAC or 24 VAC.

.3 The Local Display Unit shall be flush mounted directly to a standard electrical enclosure or DIN rail. Electrical conductors shall terminate inside the display module housing to a pluggable terminal block

.4 The display unit shall utilize an LCD display with variable contrast adjustment and backlighting to adapt the display to various lighting conditions.

.5 The display unit shall provide a means of entering and displaying a unique location descriptor that may be used to identify the location and/or function of the display unit. The descriptor shall allow up to two lines of at least 13 alphanumeric characters to be entered in the description field

.6 The display unit shall allow access to pertinent flow, temperature, humidity, pressure data, as well as occupancy and emergency mode control status, and current device or system alarm status. Data shall be viewable in units of measure appropriate for users of the system.

.7 The display unit shall have the ability to display up to 250 parameters, organized into display screens of up to five parameters per screen. Each screen shall have the ability to have a descriptive name of up to 16 alphanumeric characters for ease of navigation. Each parameter being displayed shall have the ability to include such information as:

.1 Descriptive tag (up to 13 alphanumeric characters)

.2 Present value, which may be read directly off the network, or conditioned with a fixed multiplier and/or offset to scale the value for the desired units of measure

.3 Units of measure, which are configurable based on local user conventions

.8 Set points and editable control parameters shall be viewable on the Local Display Unit. The user shall have the ability to enable a pass code to prevent unauthorized changes to set points and editable control parameters.

2.6 FUME HOOD AND SASH POSITION MONITOR

.1 A fume hood monitor shall be provided along with a sash position monitor to be installed inside the fume hood by fume hood manufacture at the factory. This same monitor shall generate an exhaust airflow control signal for the appropriate airflow control device in order to provide a constant average face velocity. Audible and separate visual alarms shall be provided for flow alarm and emergency exhaust conditions. The fume hood monitor shall incorporate the following capabilities:

.1 LED display with the ability to display one of the following measurements:

.1 Cubic feet per minute (CFM)

.2 Metres cubed per hour (m3/h)

.3 Feet per minute (fpm)

.4 Metres per second (m/s)

.2 Alarm muting option, which silences the audible alarm for an adjustable time period when the mute button is pushed. If another alarm is generated during the mute period, the new alarm will override the mute delay and the alarm will sound again

.3 Auto alarm muting option, which sets the alarm to mute automatically after 20 seconds.

.4 Emergency Exhaust button with LED, which activates an emergency exhaust mode. In this mode, the exhaust air is at its maximum flow. When activated, the alarm will sound and the LED will flash. To activate emergency exhaust mode, push the button. Push the button again to cancel emergency exhaust mode.

.5 Flow Alarm LED, which illuminates to indicate an unsafe airflow condition. The audible alarm will also activate and may be muted.

.6 Broken retracting cable alarm, an audible alarm with a flashing LED that indicates whether a vertical sash sensor cable is detached, thereby ensuring the fume hood users' safety.

.7 Diversity Alarm LED that can be activated locally or from the BAS system. No audible alarm will be generated at the fume hood monitor.

.8 Energy waste alarm option, which generates a local visual and audible alarm to notify when the fume hood sash is open beyond its minimum flow position and the lights in the room are off. When activated, the LED display will show "ENRG" and the audible alarm will sound until the sash is closed. The light levels at which the alarm is both initiated and cancelled shall be configurable. Alternatively, the sash position will be provided to the BAS and set as an alarm.

.9 Fume hood decommissioning option, which commands the exhaust flow through the fume hood to the minimum allowed by the exhaust valve when the sash is fully closed and no chemicals are present in the hood. The mode shall be initiated by either a pushbutton sequence on the fume hood monitor, external momentary switch input to the fume hood monitor, or a network command. When activated, the LED display will show "OFF," and the exhaust valve will move to its minimum position or shutoff position. Safety shall be built into the decommission option, whereby opening the fume hood sash will automatically return the fume hood exhaust to an in-use operating volume as determined by the sash sensor. Fume hood decommissioning shall be a point that can be integrated to the BAS system.

2.7 ROOM SENSORS

.1 For variable air volume (VAV) systems in laboratories with new fume hoods, a sash sensor shall be provided to measure the height of each vertically moving fume hood sash. Control systems employing sidewall-mounted velocity sensors shall be unacceptable.

.2 A presence and motion sensor shall be provided to determine an operator's presence in front of a hood by detecting the presence and/or motion of an operator, and to command the LACS from an in-use operating face velocity (e.g., 0.41 m/s) to a standby face velocity (e.g., 0.3 m/s) and vice versa

.1 The sensor shall define an adjustable detection zone that extends approximately 50 cm (20 inches) from the front of the fume hood. If the sensor does not detect presence and/or motion in its detection zone within 30 to 3,000 seconds, it shall command the system to the user-adjustable standby face velocity. When the sensor detects the presence and/or motion of an operator within the detection zone, it shall command the system to the in use face velocity within 1.0 second

.2 The sensor shall sense an inanimate object when placed in the detection zone and remain in the standard mode of operation for 30 to 3,000 seconds, after which it will return to a standby mode. Operators shall enter and leave the zone with the unit adjusting automatically between in-use and standby modes. If the inanimate object is moved or taken out of the zone, the unit shall adapt to the change automatically.

.3 The sensor shall have an adjustable detection zone capable of covering a fume hood up to 2400mm wide and be mounted from 1800mm to 2400mm feet above the floor surface.

.4 The sensor shall be configurable for varying levels of lighting intensity and motion sensitivity.

.5 The sensor shall have the ability to operate on either AC or DC power sources.

.6 Wide area motion detectors (on the hood or at the room level) shall be unacceptable.

.3 The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow set points to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to assure flow through the fume hood even with the sash fully closed.

2.8 INDUCTION UNITS

.1 Induction units shall be as indicated on the Mechanical and Architectural Drawings and shall meet the capacity and acoustical performance requirements specified and indicated on the mechanical equipment schedules. Performance data shall be based on the installation above a one or two way discharge diffuser with a maximum airflow resistance of 7.5 Pa (0.03 in H_2O).

.2 Induction units shall be designed to fit in the enclosure. All units shall consist of a casing, primary air plenum, water coil frame and mixing chamber manufactured from 20 GA G-60 galvanized sheet steel conforming to ASTM-653 standards. The primary air plenum shall deliver air through a series of induction nozzles and into a mixing chamber. Secondary air shall be drawn into the side of the unit through the vertically mounted water coil and combined with the primary air in the mixing chamber. A single oval air connection spigot shall be mounted on the side or at the end of the unit as indicated on the Drawings. All sheet metal joints in the primary air plenum and air connection spigot shall be sealed airtight. The overall height of the unit shall not exceed 290mm (11½").

.3 Primary air shall be discharged into the mixing chamber through multi-lobed induction nozzles. The size and quantity of nozzles shall be selected to provide the primary and secondary airflows at the inlet static pressure and noise levels specified. Nozzles shall be manufactured from UL 94 V-0 flame retardant thermoplastic.

.4 Induction units shall be fitted with a commissioning tube for measuring the static pressure differential between the primary air plenum and the room. Each unit shall be provided with an airflow calibration chart showing primary airflow rate for given nozzle configuration at different static pressures.

.5 Secondary water coils shall be two pipe configuration as indicated on the schedules. The single vertically mounted coil shall be manufactured with 12mm (½") seamless copper tubing with a minimum 0.016" wall thickness mechanically expanded into corrugated aluminum fins spaced at 12 fins per inch. Coils shall be fitted with a condensate pan manufactured from welded G-60 galvanized steel and powder coated black. The condensate pan shall be sloped at least 1% in accordance with ASHRAE standard 62 and fitted with a plastic capped 12mm (½") O.D copper drain connection. Water velocity in the tubes shall be at least 0.254 m/s (50 FPM) and not exceed 1.219 m/s (240 FPM). The coils shall have a maximum working pressure of no less than 2068 kPa (300 PSI) and be factory tested for leakage at 3447 kPa (500 PSI). Coils shall be rated in accordance with AHRI standard 410. Coil connections shall be 12mm (½" O.D.) bare copper for field sweating to the water circuit. Water coils connection handing shall be as shown on the Drawings.

.6 Induction unit shall be delivered to site clean and flushed. Each unit shall be labeled with identification tagging and commissioning requirements for primary air and chilled water flow. Units shall be individually packaged in cardboard cartons and palletized on wooden skids.

.7 The manufacturer shall provide the following options where marked on the Schedules and Drawings

.1 ½“ thick thermal insulation applied to the interior of the primary air plenum to prevent condensation forming on the outside of the unit casing and the interior surfaces of the primary air chamber. Thermal insulation shall be manufactured in accordance with ASTM C1071-05, UL-181 (Air Erosion) and ASTM E84 25/50 (flame spread and smoke density) standards.

.2 Removable lint screen shall be installed on the face of the coil.

.3 ½“ NPT female threaded connections fitted to the water coil, suitable for field connection to a ½“ NPT male flexible hose.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for air terminal units installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where air terminal units are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support equipment independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

.5 Induction Units

.1 Induction unit shall be independently suspended from the wall structure at four points.

.2 Air connections to the main primary air duct shall be made with flexible duct with all joints sealed and made airtight.

.3 Flexible hoses shall comprise a PTFE lined hose with stainless steel wire braided jacket rated for a maximum operating pressure of not less than 500 PSI at 200°F.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for 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.

.6 Dimensions.

1.2 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect diffuser, registers and grilles 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 and packaging materials as in accordance with Section 01 74 20.

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 Frames where set into gypsum board and as indicated on drawings.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as indicated on drawings.

2.3 MANUFACTURED UNITS

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

2.4 SUPPLY GRILLES AND REGISTERS

.1 As indicated on drawings.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 As indicated on drawings.

2.6 DIFFUSERS

.1 As indicated on drawings.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where the diffuser, grille, or register is to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, in areas which may be subject to accidental impact.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 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)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Pressure drop.

.2 Face area and free area.

.3 Free area velocity.

.4 Required opening size

.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 E 90.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect louvers, intakes and vents 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 and packaging materials in accordance with Section 01 74 20.

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 CANOPY HOODS

.1 General: provide canopy hoods as indicated on drawings. Canopy hoods to be constructed of 304 stainless steel and fabricated in accordance with SMACNA standards and guidelines

.2 Canopy to be 2050 mm x 750 mm, with connection to exhaust ductwork as indicated on drawings.

2.3 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured galvanized steel hinged at curb line.

.1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.

.2 Horizontal backdraft dampers.

.3 Maximum throat velocity: 3.3 m/s intake.

.4 Maximum loss through unit: 15 Pa static pressure.

.5 Maximum velocity through damper area: 1.5 m/s.

.6 Dimensions: as indicated.

.2 Birdscreens:

.1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 19 mm mesh on intake.

2.4 GOOSENECK HOODS

.1 Thickness: to SMACNA.

.2 Fabrication: to SMACNA.

.3 Joints: to SMACNA. Proprietary manufactured flanged duct joint considered class A seal.

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 19 mm mesh on intake].

.6 Horizontal backdraft dampers.

2.5 FIXED LOUVRES

.1 General: wind-driven rain resistant stationary louver.

.2 Frame:

.1 127mm deep, 6063T extruded aluminum with 2.1mm nominal wall thickness

.3 Blades:

.1 6063T5 extruded aluminum 1.6mm nominal wall thickness

.2 Durable drainable blades to be sightproof and spaced approximately 51mm centre to centre

.4 Screen

.1 16mm x 1mm expanded flattened aluminum bird screen in removable frame

.5 Finish: prime coated. Colour: to Departmental Representative's approval.

.6 Accessories

.1 To be provided with filter racks where indicated on drawings

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions on site to confirm adequate room to install louvres in existing wall or ceiling without impacting existing equipment, piping, or building services.

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 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 National Fire Prevention Association (NFPA)

- .1 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

- .1 ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. WITHDRAWN

.3 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-115.13-85, Filter Media, Automatic Roll (Reaffirmed April 1985).
- .3 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
- .4 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
- .5 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
- .6 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
- .7 CAN/CGSB-115.20-95, Polarized Media Air Filter.

.4 Underwriters' Laboratories of Canada

- .1 ULC-S111-07, Standard Method of Fire Tests for Air Filter Units.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawing and product data in accordance with Section 01 33 00.

.2 Indicate the following:

- .1 Minimum Efficiency Reporting Value
- .2 Pressure drop
- .3 Size

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.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.

1.5 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.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.

1.6 EXTRA MATERIALS

.1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00.

Part 2 PRODUCTS

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50°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 otherwise.

.2 Seals: to ensure leakproof 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 or as indicated on drawings.

2.3 CARTRIDGE TYPE FILTERS 95 %EFFICIENCY

.1 Media: disposable, high efficiency, to CAN/CGSB-115.15.

.2 Holding frame: galvanized steel with bracing.

.3 Media support: welded wire grid.

.4 Performance: average atmospheric dust spot efficiency 95% to ASHRAE 52.1.

.5 Fire rated: to ULC-S111.

2.4 FILTER GAUGES - DIAL TYPE

.1 Diaphragm actuated, direct reading.

.2 Range: 0 to 2 times initial pressure (0 to 250 Pa).

2.5 FILTER GAUGES - MANOMETER TYPE

.1 Inclined acrylic tube.

.2 Complete with levelling screws.

.3 Range: 0 to 2 times initial pressure (0 to 250 Pa).

Part 3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.2 REPLACEMENT MEDIA

.1 Replace all media with new upon acceptance.

.2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 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.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for chimneys and stacks and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 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.

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with CEPA.

.2 Certifications:

.1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect chimneys and stacks 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 and packaging materials in accordance with Section 01 74 20.

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 mineral wool insulation with mated fittings and couplings.

.1 Liner: 0.889 mm thick, type 316 stainless steel.

.2 Shell: 0.559 mm thick, type 316 stainless steel.

.3 Outer seals between sections: to suit application, as recommended by manufacturer.

.4 Inner seals between sections: to suit application, as recommended by manufacturer.

2.3 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 and manufacturer’s instructions.

.4 Rain cap.

.5 Expansion sleeves with heat resistant caulking, held in place as indicated.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for chimney and stack installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where chimney is to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 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 B51-14, 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)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Fuel input capacity and heating output capacity

.2 General arrangement showing terminal points, instrumentation test connections.

.3 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.4 Foundations with loadings, anchor bolt arrangements.

.5 Piping hook-ups.

.6 Equipment electrical drawings.

.7 Burners and controls.

.8 All miscellaneous equipment.

.9 Flame safety control system.

.10 Breeching and stack configuration.

.11 Stack emission continuous monitoring system to measure CO, O, NOx, SO, stack temperature and smoke density of flue gases.

.2 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, and 100%, 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.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Provide factory tests to check construction, controls, and operation of unit.

.2 Provide authorized boiler inspection prior to shipment and submit copy of inspection report to Departmental Representative.

.3 Boilers shall be guaranteed to operate at a minimum efficiency above 89% for the entire range of firing rate, 100% to 35%.

.4 Boiler shall be suitable for continuous low water temperatures as low as 21°C.

.5 The boiler pressure vessel shall be warranted against thermal stress cracking for a period of ten years from date of shipment. The warranty shall cover the boiler pressure vessel under all operating conditions.

.6 The entire heat exchanger and burner shall carry a 3-year limited warranty. The heat exchanger shall also have a 10-year limited warranty against thermal shock.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra materials:

.1 Submit maintenance materials in accordance with Section 01 78 00.

.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.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect boiler and equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.7 WARRANTY

.1 Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

.2 Warranty Period for Fire-Tube Condensing Boilers

.3 The pressure vessel/heat exchanger shall carry a 10-year from shipment, non-prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.

.4 Manufacturer labeled control panels are conditionally warranted against failure for (2) two years from shipment.

.5 All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment

Part 2 PRODUCTS

2.1 GENERAL

.1 Description:

.1 Boiler shall be natural gas fired, fully condensing, fire tube design. Power burner shall have full modulation (the minimum firing rate shall not exceed 200,000 BTU/HR input. Boilers that have an input greater than 200,000 BTU/Hr at minimum fire will not be considered) and discharge into a positive pressure vent. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Boiler shall be factory-fabricated, factory-assembled and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return and condensate drain connections, and controls.

2.2 CONSTRUCTION

.1 Heat Exchangers:

.1 The heat exchanger shall be constructed of 439 stainless steel fire tubes and tubesheets, with a one-pass combustion gas flow design. The fire tubes shall be 5/8” OD, with no less than 0.049” wall thickness. The upper and lower stainless steel tubesheet shall be no less than 0.25” thick. The pressure vessel/heat exchanger shall be welded construction. The heat exchanger shall be ASME stamped for a working pressure not less than 160 psig. Access to the tubesheets and heat exchanger shall be available by burner and exhaust manifold removal. Minimum access opening shall be no less than 14-inch diameter.

.2 Pressure Vessel:

.1 The pressure vessel shall have a maximum water volume of 55 gallons. The boiler water pressure drop shall not exceed 3 psig at 258 gpm. The boiler water connections shall be 4-inch flanged 150-pound, ANSI rated. The pressure vessel shall be constructed of SA53 carbon steel, with a 0.25-inch thick wall and 0.50-inch thick upper head. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases

.3 Modulating Air/Fuel Valve and Burner:

.1 The boiler burner shall be capable of a 15-to-1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 20 ppm of NOx corrected to 3% excess oxygen. The burner shall be metal-fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. A variable frequency drive (VFD), controlled cast aluminum pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner

.4 Minimum Boiler Efficiencies shall be as per below at 20degree delta T.

EWT	100% Fire	50% Fire	5% Fire
160 °F	87%	87%	87%
140 °F	88%	88%	88%
120 °F	89%	90%	90.5%
100 °F	93.7%	95%	95%
80 °F	96%	98%	98.6%

.5 The exhaust manifold shall be of corrosion resistant cast aluminum or 316 stainless steel with an 8-inch diameter flue connection. The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.

.6 Blower: The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

.7 Ignition:

.1 Ignition shall be via regulated staged spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

.2 The boiler shall be designed such that the combustion air is drawn from the inside of the boiler enclosure, decoupling it from the combustion air supply and preheating the air to increase efficiency.

.8 Enclosure:

.1 The sheet metal enclosure shall be fully removable, allowing for easy access during servicing.

2.3 CONTROLS

.1 The boiler control system shall be segregated into three components: “C-More” Control Panel, Power Box and Input/Output Connection Box. The entire system shall be Underwriters Laboratories recognized.

.2 The control panel shall consist of six individual circuit boards using state-of-the-art surface-mount technology in a single enclosure. These circuit boards shall include:

.1 A display board incorporating LED display to indicate temperature and a vacuum fluorescent display module for all message enunciation

.2 A CPU board housing all control functions

.3 An electric low-water cutoff board with test and manual reset functions

.4 A power supply board

.5 An ignition /stepper board incorporating flame safeguard control

.6 A connector board

.3 Each board shall be individually field replaceable.

.4 The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.

.5 The control panel hardware shall support both RS-232 and RS-485 remote communications.

.6 The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities that incorporate a minimum of eight separate status messages and 34 separate fault messages.

.7 The control panel shall incorporate three self-governing features designed to enhance operation in modes where it receives an external control signal by eliminating nuisance faults due to over-temperature, improper external signal or loss of external signal. These features include:

.1 Setpoint High Limit: Setpoint high limit allows for a selectable maximum boiler outlet temperature and acts as temperature limiting governor. Setpoint limit is based on a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degree selectable band from the desired maximum boiler outlet temperature.

.2 Setpoint Low Limit: Setpoint low limit allows for a selectable minimum operating temperature.

.3 Failsafe Mode: Failsafe mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can to shut off the unit upon loss of external signal, if so desired.

.8 The boiler control system shall incorporate the following additional features for enhanced external system interface:

.1 System start temperature feature

.2 Pump delay timer

.3 Auxiliary start delay timer

.4 Auxiliary temperature sensor

.5 Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate

.6 Remote interlock circuit

.7 Delayed interlock circuit

.8 Fault relay for remote fault alarm

.9 Each boiler shall include an electric, single-seated combination safety shutoff valve/regulator with proof of closure switch in its gas train. Each boiler shall incorporate dual over-temperature protection with manual reset, in accordance with ASME Section IV and CSD-1.

.10 Each boiler shall have an oxygen monitoring system that will measure the oxygen content of the exhaust gasses in real-time. Output of O2 information shall be displayed on the C-More control panel.

.11 Each boiler shall have integrated Boiler Sequencing Technology (BST), capable of multi-unit sequencing with lead-lag functionality and parallel operation. The system will incorporate the following capabilities:

.1 Efficiently sequence 2-to-8 units on the same system to meet load requirement.

.2 Integrated control and wiring for seamless installation of optional isolation valve. When valves are utilized, the system shall operate one motorized valve per unit as an element of load sequencing. Valves shall close with decreased load as units turn off, minimum of one must always stay open for recirculation.

.3 Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load in an effort to equalize unit run hours.

.4 Designated master control, used to display and adjust key system parameters.

.5 Automatic bump-less transfer of master function to next unit on the chain in case of designated master unit failure; master/slave status should be shown on the individual unit displays.

.6 Designated master control, used to display and adjust key system parameters.

.12 Controls interface with BACnet shall utilize an optional Communications Gateway to act as a MODBUS interface/translator between the BAS and either the RS-485 port of the boiler control panel or the RS-232 port of the ACS.

2.4 ELECTRICAL POWER

.1 Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers and other electrical devices shall provide a single-point field power connection to the boiler.

.2 Electrical Characteristics:

.1 Voltage: 208 V

.2 Phase: Three

.3 Frequency: 60 Hz

.4 Full-Load Current 16.0 Amps

2.5 VENTING

.1 The exhaust vent must be ULc Listed for use with Category II, III and IV appliances and compatible with operating temperatures up to 230°F, positive pressure, condensing flue gas service. ULc-listed vents of Polypropylene and Al29-4C Stainless steel must be used with boilers.

.2 The minimum exhaust vent duct size for each boiler is eight-inch diameter.

2.6 AUXILIARIES

.1 Provide auxiliaries for each boiler and to meet ASME requirements.

.2 Hot water boilers:

.1 Relief valves: ASME rated, set in accordance with manufacturer’s instructions.

.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.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for heating boiler installation in accordance with manufacturer's written instructions.

.1 Visually inspect site area as indicated on drawings.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

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.

.5 Pipe hot water relief valves full size to nearest drain.

.6 Pipe blowdown/drain to blowdown tank/floor drain.

.7 Natural gas fired installations: in accordance with CSA B149.1.

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 48 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.7 PERFORMANCE VERIFICATION

.1 Verify startup of equipment in accordance with manufacturer’s checklist

.2 Conduct Performance verification in accordance with Section 01 91 13.

.3 Conduct flue gas analysis by the manufacture to meet applicable codes and submit the report to Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, 2010.

.2 CSA International

.1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Shop drawings to indicate:

.1 Dimensions and weight of heat exchanger.

.2 Output capacity

.3 Flow rates and pressure drops of primary and secondary sides

.4 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

.7 Manufacturers Reports:

.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra tock Materials:

.1 Submit in accordance with Section 01 78 00.

.2 Supply following spare parts:

.1 Head gaskets

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect heat exchangers 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 and packaging materials as specified in Section 01 74 20.

1.6 QUALITY ASSURANCE

.1 Design and construction shall meet requirements of ASME code for unfired pressure vessels

Part 2 PRODUCTS

2.1 EQUIPMENT

.1 Plate Heat Exchanger:

.1 Steam to water and steam to steam, as indicated.

.1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code, CSA B51, and provincial pressure vessel regulations.

.2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.

.3 Plates: type 316 stainless steel.

.4 Gaskets: as recommended by manufacturer to suit fluid temperature.

.5 Supports: as indicated.

.6 Piping connections: as indicated.

.7 Capacity: as indicated on drawings.

.8 Dimensions: as indicated on drawings.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions on site to confirm adequate clearance for equipment, piping and valves.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.

.3 Plate exchangers: install in accordance with manufacturer's recommendations.

3.3 APPURTENANCES

.1 Install with safety relief valve piped to drain.

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

.3 Install pressure gauge on steam inlet.

3.4 FIELD QUALITY CONTROL

.1 Site Tests and Inspections:

.1 Perform tests as directed by Departmental Representative to ensure heat exchangers are functional.

.2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

.2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.3 Manufacturer's Field Services:

.1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.2 Ensure manufacturer's representative is present before and during critical periods of installation and testing.

.3 Schedule site visits:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Upon system startup.

3.5 SYSTEM START-UP

.1 General: perform start-up operations in accordance with Section 01 91 13, supplemented as specified herein.

.2 Check heater for cleanliness on primary and secondary sides.

.3 Check water treatment system is complete, operational and correct treatment is being applied.

.4 Check installation, settings, operation of relief valves and safety valves.

.5 Check installation, location, settings and operation of operating, limit and safety controls.

.6 Check supports.

.7 General: perform performance verification in accordance with Section 01 91 13, supplemented as specified.

.8 Timing: only after TAB of hydronic systems have been successfully completed.

.9 Primary side:

.1 Measure flow rate, pressure drop, and either steam pressure at heater inlet or water temperature at heater inlet and outlet, as applicable to heat exchanger primary heat source.

.1 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.

.2 Control valve: verify proper operation without binding, slack in components. Measure either steam pressure at control valve inlet or if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.

.3 Secondary side:

.1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.4 Calculate heat transfer from primary and secondary sides.

.5 Simulate heating water temperature schedule and repeat above procedures.

.6 Verify settings, operation, safe discharge from safety valves and relief valves.

.7 Verify settings, operation of operating, limit and safety controls and alarms.

.8 Reports:

.1 In accordance with Section 01 91 13, supplemented as specified herein.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.7 DEMONSTRATION

.1 Training: provide training in accordance with Section 01 91 13.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Definitions:

.1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

.2 Reference Standards:

.1 National Fire Prevention Association (NFPA)

.1 NFPA-90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 Edition.

.2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)

.1 ASHRAE 90.1-2010, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASHRAE 52.2- 2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 Air Conditioning and Refrigeration Institute (ARI)

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.5 Master Painters Institute (MPI)

.1 MPI-INT 5.3-2007, Galvanized Metal.

.6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

.7 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1113-04, Architectural Coatings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for refrigerant, insulation, filters, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate following:

.1 Product data for new coils and fans.

.2 Indicate unit dimensions, unit weight, required clearances, wall, door and base construction details, coil rack and drain pan details, isolation base detail, isolator selection, field connection details, damper details, lifting lug details, and trapping requirements for cooling coil condensate.

.3 Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, metal gauges and finishes of materials.

.4 Provide fan curves with specified operating point clearly plotted.

.5 Submit sound power levels for both fan inlet and outlet at rated capacity. Provide sound power levels at the inlet and outlet of the unit.

.6 Submit product data of filter media, filter performance data, filter assembly, and filter frames.

.7 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

.8 Submit manufacturers recommended installation instructions.

.9 Detailed proposal drawings shall be provided to and accepted by the engineer before beginning any unit modifications.

.10 Epoxy submittal sheets shall be supplied as part of the shop drawings.

.11 Refurbishment phasing procedure to assure continuous operation of the air handling unit during occupied hours.

.1 Provide submittals for all solvent and epoxies utilized confirm low VOC and non-toxic concentrations.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse of pallets, crates, paddling and packaging materials in accordance with Section 01 74 20.

1.6 SCOPE

.1 To extend the useful life of the existing AHU-1 by replacing many of the major components and refurbishing the casing and flooring. Components being replaced consist of the return fan, pre-heat coil, supply fan, steam humidifier grid and steam generator, multizone cooling and heating coils.

.2 Prior to beginning any unit modifications the contractor is responsible to site measure the existing silencer air pressure drop. Since silencers will be removed, the new fan selections shall reflect the reduced system static pressure and be reflected in the fan submittals.

1.7 QUALITY ASSURANCE

.1 The refurbishment shall be carried out in coordination with the operating requirements of the facility and in a workmanlike manner. A proposed plan for refurbishment of AHU-1, complete with schedule indicating AHU shut-down time and component installation time is to be submitted for review within 60 days of award. Proposed refurbishment plan to be complete with detailed shop drawings of each component to be refurbished.

.2 Detailed schedule and proposal drawings shall be provided to and accepted by the Departmental Representative before beginning any unit modifications. No time extensions will be provided for unacceptable submissions.

.3 All materials used shall comply with current NBC and NFPA code requirements.

.4 Replacement fans shall conform to AMCA bulletins regarding testing and construction.

.5 New coils shall be ARI certified.

.6 Filter media shall be ULC listed.

.7 Replaced unit insulation shall be factory CSA approved.

.8 All floor surfaces and wall surfaces shall be thoroughly degreased and cleaned as required after the refurbishment.

.9 Unacceptable workmanship will be repaired and redone at no additional cost to the Departmental Representative. Time extensions will not be provided to accommodate rework due to quality issues.

Part 2 PRODUCTS

2.1 DESCRIPTION

.1 Units shall be inspected by the customer prior to approval by the Engineer. Inspection shall be of unit completely refurbished (or done in phases as required).

2.2 ACOUSTICAL PERFORMANCE OF REPLACEMENT FANS

.1 Duct silencers are being removed, so the replacement fan array performance from a sound perspective is critical. The fan manufacturer's representative shall submit sound data and provide written guarantee on the performance/compliance.

.2 Sound Power for fan array shall be at or below the given values:

	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz	dBA
Supply Array (5 fans)	93	93	101	95	92	89	87	82	98

Return Array (5 fans)	87	92	94	86	84	83	78	70	91

.3 There will be a sound test done on site by a third party agent confirming compliance to the published ratings. Non-compliance will result in silencers being installed at the expense of the mechanical contractor and/or fan supplier.

2.3 CASING AND FLOOR REFURBISHMENT

.1 Wash and degrease all surfaces with a non-toxic solvents and dry to assure liner insulation is not compromised.

.2 Complete preparation of all rusted metal surfaces inside the air handlers to remove all rust dust scale and other contaminants that may affect the adhesion of coating to the substrate.

.1 Coat all exposed cleaned metal inside of the air handler with a submersible primer/finish coat specifically designated for applications over prepared rusted metal.

.3 Should the liner be patched the new liners shall be semi-rigid Armaflex specifically designed for duct and plenum lining. All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88. Insulation shall meet NFPA 90A and 90B.

.4 All of the bare concrete floors within the AHU shall be pressure washed and degreased with a non-toxic solvent. Once this is completed the contractor shall apply a water proof industrial grade epoxy coating to all concrete surfaces. Epoxy shall be VOC compliant.

.5 Apply to the complete inside of the air handlers a broad spectrum antimicrobial, odourless colourless, non-leaching and durable cleaner.

2.4 DOOR REPAIR

.1 All access doors shall be refurbished by replacing or adjusting handles as required.

.2 Door openings shall be fully re-gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter.

.3 There should be no perceivable air leakage from any of the doors once this refurbishment has been completed.

.4 Supply and install new test ports inside each section of the unit, including upstream and downstream of each fan and coil.

2.5 FAN SECTIONS

.1 Existing fans and motors shall be completely removed from existing AHU casing and discarded from the site for recycling (this includes the concrete inertia bases).

.2 The replacement fans shall be Sound absorbing plenum fans built in a fan array of sizes as shown on the performance schedule. Each assembly shall be complete with: motor, single width single inlet (SWSI) centrifugal airfoil fan wheel, inlet cone, and integral sound attenuator.

.3 Individual fans must be less than 500lbs including motor weight, and shall be able to fit through a 60" square opening. The fan array shall ship with a prefabricated support structure to accommodate the 3x2 arrangement. Field assembly of the array shall be carried out by the contractor under the supervision of the fan supplier.

.4 Each fan shall be equipped with a variable frequency drive (VFD). VFD to be provided as per section 23 92 49.

.5 Integrated attenuator package must not increase air tunnel length or reduce fan performance. Aerodynamic performance data shall be AMCA Certified

.6 All fans shall be selected such that the design point is not greater than 85% of peak static pressure associated with design operating speed.

.7 The fan wheel shall be statically and dynamically balanced to a Balance Grade G6.3 per ANSI/AMCA 204. The motor shall be balanced in accordance with NEMA MG1. The fan shall be internally isolated.

.8 Fan blades shall be an extruded aluminum air foil shape and be welded to the front and back plate of the fan wheel. The hub shall be secured to the motor shaft with a key and three (3) set screws or a compression type coupling.

.9 Each assembly shall be provided with four (4) pressure taps mounted flush in the throat of the inlet cone. All taps shall be connected in parallel to a single barb fitting. A flow test (at wide open volume) shall be conducted on each assembly prior to installation in the air handling unit.

.10 Provide plenum fan inlets on the fan wall and air outlets from the casing with a smooth bellmouth fitting with radius to match casing thickness, and free of protruding structural members and flanges.

.11 Plenum fan assembly must have an enclosed safety screen per OSHA Standards.

.12 Motors shall have a minimum L-10 bearing life of 200,000 hours and must be supplied with fittings for re-lubrication. Select motors accordingly to ensure that the temperature at the bearing hub does not exceed 100◦ C. Sealed bearings are not acceptable.

2.6 AIRFLOW MEASURING PROBES

.1 Provide on each fan, air flow measuring probes.

.2 Each airflow probe shall contain multiple, averaged velocity pressure taps located symmetrically around the throat of the fan inlet and a single static pressure tap located on the fan housing. The entire airflow monitoring probe must be located outside the inlet throat as to not obstruct airflow.

.3 The probes shall be capable of producing steady, non-pulsating signal of the velocity pressure, independent of the upstream static pressure without adversely affecting the performance of the fan. The sensing probes shall be accurate ±3% of actual fan airflow.

2.7 AIRFLOW DISPLAY

.1 Provide on indicated fans a method of displaying digitally, in real time, the fans current air flow.

.2 The display shall be capable of showing the airflow of four (5) independent fans simultaneously.

.3 For interaction with a controller, the display shall output one (1) 0-10VDC signal for each fan being monitored.

.4 The output signal shall be accurate to ±0.5% of Natural Span, including non-linearity, hysteresis and non-repeatability.

.5 The display must be water tight allowing for use in outdoor locations. If the display is not water tight it shall be enclosed in a weatherproof housing.

.6 The display shall provide output the BAS.

2.8 COILS

.1 New coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed. All existing coil racks shall remain in place with replacement coils made to fit.

.2 Removable coil access panels shall be provided to remove coils through existing casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards the access side.

.3 All drain pans shall be replaced with double wall continuously welded 304 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 1" down pipes. Condensate drain shall be a minimum 1-1/4" diameter stainless steel tube extending 1" out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.

.4 Coils shall be certified in accordance with ARI Standard 410.

.5 Construction:

Tubes	Horizontal, copper.
Fins	Aluminum fins mechanically bonded to tubes.
Headers	Seamless copper with vent and drain connections.
Casing	16 gauge, stainless steel channels with 16 gauge center and end supports.
Connections	Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing. Roof mounted units shall have the centre of the bottom coil connections located 10” off the unit floor.

.6 Cooling coils shall have a flexible epoxy polymer e-coat uniformly applied to all casing and coil surface areas without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.8 – 1.2 mil on all surface areas including fin edges. Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-90 using scribed aluminum test coupons.

2.9 FILTER SECTIONS

.1 Filter racks shall remain, while being repaired where air leakage is determined.

.2 Provide and install a new set of filters once the refurbishment has been completed.

.3 Provide magnehelic gauges.

.1 Magnehelic gauges shall be accurate to +/- 2% of full range.

.2 Provide sensing probes and shut off valves for each gauge.

.3 Provide one gauge flush mounted into the casing for each filter bank.

2.10 ALUMINUM AIRFOIL DAMPERS

.1 Remove and replace all existing dampers with new dampers. Provide insulated gasketed dampers for OA or EA dampers.

.2 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.

.3 Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.

.4 Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.

.5 Bearing shall be designed so that there are no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.

.6 Blade linkage hardware is to be installed in frame out of airstream. All hardware to be on non-corrosive reinforced material or cadmium plated steel.

.7 Damper seals shall be designed for minimum air leakage by means of overlapping seals.

2.11 DAMPER OPERATORS

.1 Remove all existing damper operators and install new electric damper operators with all linkage and hardware internally mounted.

.2 Ensure operators are mounted in easily accessible sections of the air handling unit.

2.12 TEST PORTS

.1 Provide and install 1” diameter test ports for unit air stream testing in each plenum section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing

2.13 STEAM HUMIDIFIER (REFER TO DETAILED HUMIDIFIER SPEC SECTION)

.1 Remove existing direct steam injection grid and replace with Steam to Steam heat exchanger and new dispersion grid. Steam supply and drain connections shall be on the same side of the AHU access.

.2 All pressurized steam lines, domestic water feed, steam condensate, drain down piping, etc shall be in the scope of work of the contractor.

2.14 ELECTRICAL

.1 Field wire all electrical devices as required. This includes a separate feed to all of the fans in the array (supply and return), as well as from the VFDs to the fan motors within the AHU.

.2 Supply two @ 600V/60 Hz/3 Ph power connection for motors and other large electrical devices and one @ 120 V/208V/60 Hz/1 Ph power connection for lights, etc.

.3 Provide a separate 120 V/ 1 phase feed for a 20 amp convenience outlet.

.4 Provide a 24V power feed to any airflow device as required.

.5 Provide 120V power feed to the new humidifier panel. Also field install the humidifier control devices and safeties as required.

.6 Provide necessary circuit breakers and/or fuses for each type of electric device.

.7 A bonding wire shall be provided between the motor loads and the electrical panel. Use of the air handling unit casing for a bond will not be accepted.

.8 Provide a system of motor control including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, auxiliary contactors and terminals for the connection of external control devices or relays. Individually fuse all fan and branch circuits.

.9 Wire from the motors to the motor control in accordance with the local electrical code and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks. At all split sections, provide a 1 foot long piece of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor.

.10 External disconnects shall be provided in a NEMA 4 enclosure for superior water protection. Disconnects must be interlocked with the electrical panels for added personnel safety.

.11 All factory and field wiring and assembly shall be done in accordance with the C.E.C.

.12 The contractor shall be responsible for obtaining electrical approval of the final assembly.

2.15 DRAIN PANS

.1 Construction: stainless steel. Rounded corners.

.2 Drain connection: in bottom at low point.

.3 Installation: slope without sag minimum 1% to ensure no standing water.

.4 Dimensions: minimum 75 mm from upstream face of coil to 300 mm beyond downstream face of coil or eliminator and to include return bends and headers.

2.16 FINISH

.1 Prepare the entire outside of the air handler, removing any loose pain, fixing any holes or rusted areas.

.2 Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, color as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal

2.17 VIBRATION TESTING AND BALANCING

.1 Fans and motors shall be dynamically balanced to exceed a BV-5 criterion as per AMCA 204-96. The test shall be conducted after the fan and motor base assembly has been completed. The entire fan assembly including fan wheels, shafts, bearings, drives, belts, motors, isolation bases shall be tested. During the test, the fan and motor base shall be supported by its isolators which are set in the freely floating operating position.

.2 The required measurement points are as follows: one horizontal measurement and one vertical measurement shall be taken for each fan and motor bearing and one axial measurement shall be taken for each shaft. The measurements shall be taken using calibrated, magnetically mounted accelerometers and a calibrated measuring instrument.

.3 Vibration measurement locations shall be as close as possible to the bearing or shaft centerlines. Measurements shall be taken from the bearing housings, bearing pedestals, or motor casings. Measurements shall not be taken from flexible covers or shields.

.4 Fans and motors shall be tested at the design RPM and the maximum overall filter-in vibration levels at each measurement point shall be less than or equal to 0.15 in/second peak velocity at the operating speed. If any measurements exceed the above criterion, the assembly shall be rebalanced and re-tested until the criterion is achieved.

.5 Certified measurements shall be provided to the consultant.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Fabricate to provide smooth air flow through components.

.3 Apply sealer into seams prior to assembly.

3.3 EXECUTION

.1 Provide all water piping so water circuits are serviceable, without having to dismantle excessive lengths of pipe.

.2 Provide valves in water piping upstream and downstream of each coil for isolating the coils for maintenance and to balance and trim the system.

.3 Provide drain valves and vent cocks to each coil.

.4 Provide strainers ahead of all pumps and automatic modulating valves.

.5 Provide certified wiring schematics to the electrical division for the equipment and controls.

.6 Provide all necessary control wiring as recommended by the manufacturer.

.7 Provide condensate traps in accordance with manufacturers recommendations.

.8 Insulate all piping and equipment that has been replaced.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.5 TESTING

.1 Preheat, heating and cooling coils shall be tested to verify that the performance meets the scheduled output.

.2 Prior to refurbishment, each section of AHU-1 shall be pressure tested to determine baseline performance. Following refurbishment, AHU-1 shall be subject to a negative pressure test in the field to ensure excessive air leakage will not affect unit performance. Air leakage rate of refurbished AHU-1 shall demonstrate a 25% improvement against baseline measurements.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430-2014, Central-Station Air-Handling Units.

.2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2013, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-07, Environmental Standard for Paints.

.5 Master Painters Institute (MPI)

.1 MPI-INT 5.3-2007, Galvanized Metal.

1.2 QUALITY ASSURANCE

.1 Meet the requirements of CSA, Provincial and Municipal Codes, and be CSA listed.

.2 Test and rate the cooling systems to AHRI Standard 210.

.3 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer, or certified maintenance service shop.

.4 Provide start-up service by factory trained representative to make adjustments, perform efficiency tests, start up units, and provide training.

.5 The unit shall be fully assembled and tested prior to shipment. A detailed pre-shipment test report shall be provided to the Departmental Representative.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate following:

.1 Supply air capacity
.2 Heating input and output capacity
.3 Heating coil fluid flow rate and pressure drop
.4 Cooling input and output capacity
.5 Cooling coil fluid flow rate and pressure drop
.6 Total and external fan static pressure
.7 Fan BHP
.8 Fan curves showing point of operation
.9 Motor drive type
.10 Bearing life
.11 Minimum Efficiency Reporting Value for filters
.12 Damper size and actuator type.
.13 Electrical characteristics including voltage, phase, current draw

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

.2 Include following: completed manufacturer’s startup checklist from the time of Commissioning, Commissioning Report, copy of final shop drawing .

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Provide one spare set of filters.

.3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.4 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 and with manufacturer’s written instructions.

.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 in accordance with Section 01 74 20.

1.7 STARTUP SERVICE AND WARRANTY

.1 Manufacturer shall furnish a factory trained service technician to perform the unit startup. Manufacturer shall provide instruction to the Departmental Representative on the operation and maintenance of the unit. Factory technician to provide copy of start-up log to Departmental Representative and to demonstrate operation and maintenance to Departmental Representative. The warranty period shall commence at the date of initial startup and shall continue for a period of one (1) year not to exceed eighteen (18) months from shipment. Manufacturer's warranty shall include all parts and labour to install parts.

Part 2 PRODUCTS

2.1 GENERAL

.1 Factory assembled components to form units supplying air at designed conditions, as indicated.

.2 Certify ratings: to ANSI/ARI 430 with ARI seal.

.3 Duct openings as indicated on drawings, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers, bypass section, gas burner, cooling coil, mixing box.

.4 This specification applies to air handling unit AHU-44.

2.2 CASINGS

.1 Solvent borne paints contain volatile organic compounds (VOCs) such as petroleum distillates. The use of paints with reduced levels of VOCs will reduce emissions.

.2 The frame and unit base shall be 15 gauge galvanized steel. Unit base shall overhang the roof curb for water runoff and shall have a formed recess that seats on the roof curb gasketing to provide a positive weather tight seal.

.3 Exterior panels of all sections shall be constructed of 17 gauge galvanized pre-painted steel. Unit cabinet shall be designed to operate at total static pressures up to 6.5 inches w.g. Floor shall be externally insulated with UL listed 1" 3/4 lb. neoprene coated insulation with a thermal rating equal to R4.2. Provide 22ga solid galvanized liner over floor insulation. Cabinet shall be insulated with UL listed 2” 1-1/2 lb. insulation with a thermal rating of R6.5 and have 22 gauge solid galvanized steel liners in all sections.

.4 Provide hinged access doors with flush mounted, single lever latching mechanisms for access to each cabinet section from both sides of the unit. Access doors shall be double walled with internal insulation and 22ga galvanized steel liners. Access doors shall seal to vinyl gasketing for a positive seal. Access doors shall have stainless steel hinges and tie backs for servicing.

.5 Lifting brackets with lifting holes shall be provided on each unit base.

.6 Provide a 22 inch long heat recovery coil section immediately downstream of the filter section.

2.3 GAS FIRED HUMIDIFICATION

.1 Provide an insulated 48 inch long, blank compartment located after the discharge plenum and out of the air stream. This section shall be complete with insulation, double wall construction, 1 kW electric baseboard heater with thermostat and a service light. This section shall contain a factory installed gas fired humidifier. Provide sealed combustion make-up air and B venting. Water supply and drain shall be provided through the base of the unit by the mechanical contactor. Solenoid valves are to be installed below the roof deck, on the water feed and drain lines serving the humidifier. Upon loss of power to the rooftop, the water feed solenoid shall close and the drain solenoid shall open, draining the humidifier tank below the roof deck.

.2 The RTU manufacturer shall factory mount the steam distribution grid in the discharge air plenum. Provide minimum absorption distance downstream as scheduled. Refer to separate Humidifier Specification for details on the Humidifier.

.3 Installing contractor shall provide a separate 115/60/1 – 25 Amp electric power supply to the humidification section of the unit.

2.4 FANS

.1 Supply fan shall be double inlet centrifugal Airfoil type unless otherwise specified on the schedules. Fans shall be statically and dynamically balanced for quiet operation. Fan wheel and housing shall be fabricated from cold rolled steel. Units shall have solid steel shafts mounted in heavy-duty 200,000 hour (L-50 life) greaseable ball bearings. The entire fan assembly shall be mounted on 2" deflection spring isolators.

.2 Fan motors shall be high efficiency l800 RPM, open drip-proof type with greaseable ball bearings. Motors shall have variable pitch sheaves and shall be mounted on an adjustable base for proper alignment and belt tension adjustment. Motors shall be high efficiency and meet applicable EPACT requirements.

.3 Inverter duty rated motors shall be supplied with a factory installed shaft grounding kit. The kit shall consist of brushes or conductive rings with micro fibers which divert unwanted shaft currents away from the bearings to the ground.

.4 The supply fan shall be provided with an expanded metal belt guard.

2.5 COOLING COIL

.1 Evaporator coils shall be multi-row type fabricated from 1/2-inch O.D. seamless copper tubing mechanically bonded to rippled and corrugated aluminum fins. Each evaporator coil refrigerant circuit shall be fed with a distributor and an adjustable thermal expansion valve. The evaporator coil shall be interlaced two circuit design.

.2 Provide a stainless steel sloped primary drain pan under the cooling coil and beyond the leaving side of the coil and underneath the cooling coil connections. The drain pan shall have a minimum slope of 1/8" per foot and be connected to a stainless steel drain connection extending through the base. Provide intermediate secondary stainless steel drain pans connected to the primary drain pan for stacked coils.

2.6 FILTERS

.1 The filter section shall be supplied complete with 2" Merv 7-30% efficient AAF pre filters and Merv 14-85% efficient 12 inch UL listed AAF Varicel cartridge filters. Filters shall be accessible from both sides of the unit.

2.7 MIXING SECTION

.1 The outside air and solar wall air shall be mixed into a mixing box complete with dampers and actuators. Outside air being introduced from both sides of each unit through a horizontal louvered intake section complete with rain lip and bird screen. The floor of the outside air section shall be sloped for water drainage. The outside and solar wall air dampers shall be sized to handle 100% of the supply air volume and arranged to converge the solar wall air and outside air streams in a mixing pattern. Dampers shall be low leak type with gasketed blade to blade contact and spring side seals. Leakage shall be less than 0.2 % at 1.5 inches air pressure differential.

2.8 WEATHER HOOD

.1 Provide unit with 100% outside air weather hood, bird screen and motorized airfoil low leak dampers. Dampers shall be low leak type with gasketed blade to blade contact and spring side seals. Leakage shall be less than 0.2 % at 1.5 inches air pressure differential. Damper motor shall be two position spring closed type.

2.9 CONDENSING SECTION

.1 Provide dual refrigerant circuits on all unit sizes. Compressors shall be heavy-duty, Copeland Scroll type. Compressors shall be complete with gauge ports, crankcase heater, sight-glass, anti-slug protection, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be mounted on resilient rubber isolators.

.2 Each unit shall have two independent refrigeration circuits. Each circuit shall be complete with a liquid line solenoid valve, low pressure control, filter-drier, liquid moisture indicator/sight-glass, thermal expansion valve, liquid line shutoff valve with charging port, discharge line shutoff valve, a manual reset high pressure safety switch, high pressure relief device and pump down switch. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. Sight-glasses shall be accessible for viewing without disrupting unit operation. Each refrigerant circuit shall provide 15 degrees of liquid subcooling. Each circuit shall be dehydrated and factory charged with Refrigerant R410A and POE oil unless the refrigerant piping is split for shipment.

.3 100% O.A. units shall be provided with hot gas bypass including a solenoid valve, hot gas bypass piping and a hot gas bypass valve on the lead refrigerant circuit.

.4 The condensing section shall have multi-row condenser coils fabricated from seamless copper tubing mechanically bonded to aluminum fins. Provide liquid line and discharge line isolation valves. Condenser coil for each refrigerant circuit shall be provided with an additional circuit for a minimum of l5 degrees of subcooling. Condenser fans shall be direct drive, steel propeller type designed for low tip speed and vertical air discharge. Condenser fan motors shall be heavy-duty, inherently protected, three-phase non-reversing type with permanently lubricated ball bearings and integral rain shield.

.5 Modulating hot gas reheat shall be factory installed on the lead circuit complete with modulating valves, micro-channel refrigerant reheat coil and dehumidification control. Controls shall maintain +/- 0.5 degree control of the reheat coil leaving air temperature.

.6 Insulate all suction lines with armaflex insulation.

2.10 HEATING SECTION

.1 The heat exchanger shall consist of a stainless steel primary and stainless steel secondary. Clean-out of the heat exchanger and turbulators shall be accomplished without removing casing panels or passing soot through the supply air passages. A flame observation port shall be provided opposite the burner. The heat exchanger shall have a condensate drain.

.2 The modulating burner shall be a forced draft type with a 20:1 turndown. The firing rate of the burner shall be determined by the position of the gas valve actuator. Actuator shall modulate the gas valve and combustion air damper via direct mechanical linkages, thus varying the furnace firing rate between low and high fire. It shall be complete with: flame supervision; integral prepurge timing; combustion air proving switch; intermittent pilot with spark ignition; and a complete gas train. The gas train shall include: main gas valve; main pressure regulator; main shutoff cock; pilot gas valve; pilot pressure regulator; pilot cock; and electronic flame supervision with 4-second time response. Flame safeguard shall be Honeywell R7795B1009 and shall be readily available through wholesale distribution networks. Flame safeguard devices that are proprietary to the unit manufacturer are unacceptable.

.3 The burner, controls and valve shall be housed within the integral burner vestibule. The vestibule door shall be hinged at the top and equipped with steel retainer rod to hold the door open for service.

.4 The burner shall be fire tested and adjusted at the factory. Final adjustments shall be made in the field at initial start up.

2.11 ELECTRICAL

.1 Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with CSA standards. All wiring shall be number coded per the electrical wiring diagrams. All electrical components shall be labeled according to the electrical diagram and be CSA recognized. Each unit shall have a 115 volt control circuit transformer, system service switch, and control circuit fuse.

.2 The supply air fan, compressor and condenser fan motor branch circuits shall be individually fused. Contactors and thermal overload protection shall be furnished for each compressor and condenser fan motor. The supply air fan motors shall have contactors and external overload protection.

.3 A terminal block shall be provided for the main power connection and a terminal board shall be provided for the low voltage control wiring. Knockouts shall be provided in the bottom of the main control panel for field wiring entrance. A separate key locked control panel shall house all controls for the condensing section. Provide a disconnect switch to cut power to the entire unit before the control panel door can be opened.

2.12 CONTROLS FOR APPLIED ROOFTOP

.1 Each unit shall be equipped with a microprocessor based control system. The unit control system shall include all required temperature and pressure sensors, input/output boards, main microprocessor and operator interface. The unit control system shall perform all unit control functions including scheduling, unit diagnostics and safeties. Control sequences shall include: variable air volume, cooling/modulating heating discharge temperature control (VAV-DTC); duct static pressure control; supply/return air fan tracking control and building static pressure control. All boards shall be individually replaceable for ease of service. All microprocessors, boards, and sensors shall be factory mounted, wired and tested.

.2 The unit control system shall have the ability to communicate with an independent Building Management System (BMS) via a direct (BACnet Ethernet) communication connection. The independent BMS system shall have access to “read only’ variables and “read & and write” variables. Communications shall not require field mounting of any additional sensors or devices at the unit. The BMS system shall be capable of interacting with the individual rooftop controllers in the following ways:

Monitor controller inputs, outputs, set points, parameters and alarms
Set controller set points and parameters
Clear alarms
Reset the cooling and heating discharge air temperature set point (VAV -DTC units)
Reset the duct static pressure set point (VAV units)
Set the heat/cool changeover temperature (VAV -DTC units)
Refer to control diagram on M6.xx series drawings for sequence and control points required.

It will be the responsibility of the Systems Integrating Contractor to integrate the rooftop data into the BMS control logic and interface stations.

.3 Refrigeration capacity control shall be accomplished by staging of the unit’s multiple compressors. To maintain desired temperature control, the unit shall have a minimum of: two stages of capacity control for units up to 15 tons; four stages for units from 20 to 68 tons; six stages for units above 68 tons.

.4 Variable volume units shall be provided with Variable Frequency Drives (VFDs) and a duct high limit safety device. The DDC unit controller shall control the speed of the supply fan VFD based on the static pressure control signals from one remote sensor locations. The controller shall automatically select the lowest pressure signal. The controller shall display all setpoints and status on the controller display. The VFDs shall be completely factory mounted, wired and adjusted. A high pressure switch shall be factory mounted in the unit discharge air stream to shut down the supply and return air fans on an excessive build-up of pressure.

2.13 VARIABLE FREQUENCY DRIVES

.1 Provide fully programmable digital type 575/3/60 variable frequency AC drives (VFD) for the control of the supply and return fan motors. Enclose drives in NEMA 1 enclosures installed within the unit. Provide input line fuses and disconnect switch. Provide output filters on all 460 & 575 volt VFDs to limit dv/dt to 1,000 volts/0.5 micro seconds at the motor terminals. Provide a thermostatically controlled electric unit heater sized to maintain VFD enclosure above 0° C.

.2 VFD shall be totally digital pulse width modulated (PWM) type utilizing insulated gate bipolar transistors (IGBT's) in the inverter section of the drive. VFD shall accept AC line voltage variation of +10%, -15%.

.3 Provide input line reactors and/or line filters to reduce the total harmonic distortion (THD) to 5% at the point of common coupling or 3% (THD) at VFD input where analysis has shown that an incremental effect of the addition of the VFD's would cause the THD to exceed these valves as per IEEE 519-1992.

.4 VFDs shall provide the following protection:

- line over and under voltage protection
- phase loss protection
- phase unbalance protection
- inherent short circuit protection for line to line and line to ground faults
- electronic instantaneous overcurrent protection
- current limit adjustable between 25% and 120%
- internal over temperature protection
- electronic motor stall protection

.5 VFD shall have minimum 97% efficiency at maximum load and speed, minimum line side displacement power factor of 0.96 at all speeds, separately adjustable acceleration and deceleration ramps and separately adjustable minimum and maximum frequency range from 0 to 120 Hz.

.6 VFD shall be capable of starting with the fan already rotating by starting the motor at the speed the fan is operating at and then changing to the speed called for by the unit controller. Provide auto re-start after power interruption.

.7 Provide unit-mounted 32 character display control pads on each drive to monitor and adjust VFD parameters. Provide an additional main control pad in the rooftop control section outside of the airstream for monitoring and adjusting both the supply and return fan VFD.

.8 VFD's shall include remote enable/disable contacts, alarm relay, 4 to 20 mA control signal input and local/remote control.

.9 The supply, return and exhaust fan VFDs shall be mounted in the supply fan section and wired to the fans by the manufacturer. The VFD's shall be enabled and disabled by the unit controller as required.

2.14 ROOF CURB

.1 Each unit shall be provided with a prefabricated l2-gauge galvanized steel mounting curb designed and manufactured by the unit manufacturer for field assembly on the roof decking prior to unit shipment. The roof curb shall be a perimeter type with complete perimeter support of the air handling section and rail support of the condensing unit section. The curb shall be a minimum of l6 inches high and include a nominal 2 x 4-inch wood strip. Gasketing shall be provided for field mounting between the unit base and roof curb. The roof curb shall be approved by the National Roofing Contractors Association. Provide custom roof curb adaptor to suit existing unit curb size and duct penetration through roof.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Install units in accordance with manufacturer's instructions and as indicated.

.3 Ensure adequate clearance for servicing and maintenance.

.4 Install unit on manufacturer’s roof curb, for level installation.

.5 Install unit flat and level on roof curb in accordance with manufacturers’ installation literature.

.6 Install and wire all control accessories and power wiring to the unit.

.7 Provide two (2) 115 volt electrical power feeds to the unit in addition to the main unit power feed. One shall be rated for a 15 Amp service receptacle located within the control panel. The other shall be rated for 20 Amp service to the electric heater and humidifier in the empty section out of the air stream. Terminate both 115 Volt feeds in the RTU control panel with 15 feet of extra wire on both feeders.

.8 Provide water and drain piping for the humidifier through the base of the RTU in the humidifier section. Electrically trace these water lines. Patch all holes air and water tight.

3.3 FANS

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

.3 Install vibration isolators.

3.4 DRIP PANS

.1 Install deep seal P-traps on drip lines.

.1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.6 PERFORMANCE VERIFICATION

.1 Follow manufacturer’s checklist for start-up of equipment, and simulate operation of both heating and cooling operation

.2 Performance verification of unit to be in accordance with the General requirements listed in section 01 91 13.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Supply and install complete and operational custom indoor air handling unit as indicated on Drawings and as specified.

.2 It is the intent of this specification that the manufacturer, provide air handling units designed and manufactured specifically to the requirements of this project:

.1 Provide overall dimensions and configuration as shown on the Drawings and as described in the Specifications.

.2 Take responsibility for the Consultant and operational integrity of the air handling unit.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – Common Work Results for Mechanical

.2 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment

.3 Section 20 05 93.19 – Balancing of Mechanical Systems

.4 Section 20 07 00 – Piping and Equipment Insulation

.5 Section 23 23 16 – Refrigerant Piping Specialties

.6 Section 23 40 00 – HVAC Air Cleaning Devices

.7 Section 23 63 13 – Air Cooled Refrigerant Condensers

.8 Section 23 82 16 – Coils

.9 Section 23 84 13.16 – Steam Humidification Grid Schedule

.10 Division 26 – Electrical: Coordination of electrical installations and components.

1.3 REFERENCE STANDARDS

.1 Air Movement and Control Association (AMCA):

.1 ANSI/AMCA 500-D-07, Laboratory Methods of Testing Dampers for Rating

.2 AMCA 500-L-07, Laboratory Methods of Testing Louvers for Rating

.2 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

.1 AHRI 210/240-2008, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

.1 ANSI/ASHRAE 52.1-1992, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

.2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

.3 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings

.4 National Research Council, Canada (NRC):

.1 Model National Energy Code of Canada for Buildings, 1997 (MNECB)

1.4 QUALITY ASSURANCE

.1 Construct unit in accordance with the construction details included at the end of this section, and as described herein; install electrical components in accordance with the requirements of Division 26 and the Canadian Electrical Code.

.2 The following are to be used as selection criteria and are to be as specified: Air flow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, casing leakage rates. The following are to be met within 10% of specified values: Water pressure drops.

.3 Provide unit produced by a recognized manufacturer who maintains a local service agency and parts stock.

.4 Air handling units and major components shall be products of the manufacturer regularly engaged in production of such equipment.

.5 Fans shall conform to AMCA bulletins regarding testing and construction. (Airfoil fans shall bear the AMCA certified rating seal for airflow and sound).

.6 Coils shall be ARI certified.

.7 Filter media shall be ULC listed.

.8 Unit shall be factory CSA approved.

.9 After construction, units shall be cleaned thoroughly before shipping. All floor surfaces and wall surfaces shall be thoroughly degreased and cleaned. After cleaning, units shall be shrink wrapped using a heavy gauge heat shrinkable plastic wrap.

.10 During storage, contractor shall store units in a dry heated environment. Fan wheels shall be rotated monthly during storage. Units shall be regularly inspected for moisture and any job site moisture shall be immediately removed.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 30 00 – Administrative Requirements.

.2 Submit shop drawing that include the following minimum information. Shop drawings submitted without this information will be automatically rejected:

.1 Construction details: Submit unit construction drawings for the following components:

.1 Side panels, including connection details.

.2 Top panel, including connection details.

.3 Floor, including connection details.

.4 Doors, hinges, latch, viewing port.

.5 Fan, motor and drive, mounting and isolation.

.6 Coil section.

.7 Pipe and conduit penetration through casing or floor.

.8 Drain pan.

.9 Damper, linkage and drive construction and mounting.

.2 Materials of Construction: Indicate material and gauge of all construction components.

.3 Mass Distribution Drawings: Show point loads, and recommended method of unit installation.

.4 Fan Performance Data: Submit fan performance curves as well as performance tables.

.5 Air Blenders: Make, model, selection criteria and pressure drop curves.

.6 Coils: Selection criteria indicating air side and fluid side capacities, in and out conditions, velocities, pressure drops and fouling factors. Submit a drawing showing headers, circuiting, arrangement, connection sizes, and materials of construction.

.7 Air Filters: Media, efficiency rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

.8 Vibration Isolator Shop Drawings.

.9 Humidifier shop drawings and capacities.

.10 Table indicating pressure drops through all components of the unit.

.11 Damper Shop Drawings.

.12 Detailed composite wiring diagrams showing factory installed wiring, including wiring of the control components.

.13 Sound Levels: Submit sound power levels generated by the air handling unit at the inlet and outlet of the unit and outside the fan section. List for individual octave bands in dB referenced to A rating.

Part 2 Products

2.1 DESCRIPTION

.1 Provide factory assembled air handling unit in configuration as indicated on drawings. Unit shall include all specified components installed at the factory. Field fabrication of units and their components will not be accepted.

.2 All units shall be inspected by the customer prior to shipment. Inspection shall be of unit completely assembled.

.3 The unit shall be designed to be supported by a perimeter concrete pad for indoor units and a roofcurb for outdoor units.

.4 Units too large to fit on a standard tractor trailer may be shipped to site in sections. Otherwise units shall be shipped in one piece.

2.2 ACOUSTICAL PERFORMANCE

.1 The casing shall have been tested for acoustical performance by an independent laboratory that is accredited. Manufacturers shall submit sound data in compliance with the following:

.2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.

.3 The manufacturer shall provide factory sound test reports for each air handling unit. The consultant reserves the right to witness these tests at their own discretion.

2.3 CASING

.1 Walls and roofs shall be constructed of 16 gauge galvanized steel 2" thick acoustic thermal panels. The inner liner shall be 22 gauge solid galvanized steel (316 stainless steel for lab exhaust unit). Insulation shall be 2" thick 4.5 lb. density fibreglass. All permanently joined flanged panel surfaces shall be sealed with an individual strip of 1/8" X 3/8" tape sealer. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.

.2 Internal liner shall be suitable for washing with a pressure washer or steam cleaned without risk of wetting the insulation. The liner shall be installed over top of the panel flanges and each liner seam shall be sealed with a lap joint. The wall liner shall be installed over top of the base water dam such that any water run-off from the liner will drip into the water tight base rather than into the wall panel. The roof liner shall be installed over top of the roof support so that water cannot enter the roof insulation.

.3 Units handling more than 75% outside air shall have 4" thick walls with 4" thick 4.5 lb. density insulation up to and including the heating coil section.

.4 Outdoor units shall have roof panels broken outward to provide a lapped joint watertight seal. Outdoor roofs shall be sloped a minimum of 5/8" away from the access side.

.5 On outdoor units, screws and other similar fastening devices shall not penetrate the roof deck or the top of standing seems.

2.4 INSULATION

.1 All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88.

.2 Insulation shall meet NFPA 90A and 90B.

2.5 STRUCTURAL BASE CONSTRUCTION

.1 Units shall be constructed from a minimum C6x8.2 lb./sq.ft. channel structural steel perimeter base, with 2x2x1/4 intermediate structural steel channel and angle iron supports. Perimeter structural steel base shall be designed to directly support the weight of the walls. Intermediate structural steel and angle iron shall support the weight of all internal components (i.e. fans, coils, etc.). Maximum base deflection shall be ¼ inch on unsupported spans of 12 ft. Structural steel base shall be designed so that it can be point loaded or set on an unlevel surface and shimmed by the contractor within 12 foot spans without deflecting more than ¼ inch. The structural steel base shall be either I-beam construction or C-channel (not box channel) so that the base will shed all water. Base shall be provided with lifting lugs, minimum four (4) per shipping split. Formed metal bases formed from sheet metal will not be acceptable. Base shall prevent wall panel joints from separating during lifting, transportation and rigging.

.2 Lifting lugs shall be located and engineered to properly support the loads within. Manufacturers shall provide a load point calculation along with detailed lifting lug information as part of the shop drawing package.

.3 A 0.12” thick aluminum checker plate floor shall be installed on the base. Floor seams shall be continuously welded providing a completely flat unit floor. Standing seems will not be accepted in any section. The base shall be insulated with 3" thick, 1-1/2 lb. density fibreglass insulation and sheeted with a 22 gauge galvanized steel liner. The base liner shall be broken, tack welded and sealed for rigidity and vapour barrier integrity.

2.6 ACCESS DOORS

.1 Access door construction and width shall match the rest of the unit casing. Corners shall be welded for rigidity. Spot welding of corner seems will not be accepted. 4.5 lb. density insulation shall be sandwiched between the outer and inner skins. A 10" x 10” (double pane) tempered glass window shall be provided in each door.

.2 Provide Two chrome plated “Ventlok” Model #310 high pressure latches operable from either side of the door. Hinges shall be continuous piano type stainless steel. Door openings shall be fully gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter. Door frames shall be framed from 16 gauge galvanized steel with the outside of the door flush to the unit. Minimum door width shall be as shown on the plans but in no case shall an access door be less than 18". Door height shall be the maximum permitted by the height of the unit up to 72".

.3 Doors shall open against positive pressure.

2.7 STANDARD FANS

.1 All fans shall be tested in accordance with AMCA Standards 210-70 and 310 Test Codes for Air Moving Devices. Backward inclined fans shall bear the AMCA sticker for both air and sound performance.

.2 Fan Wheels and Shafts: Provide air foil blades on all fans wheels. Provide solid shafts keyed to the fan wheel. Coat fan shaft with rust inhibitor. Hollow shafts will not be acceptable.

.3 Fan bearings shall be self aligning pillow block, grease lubricated, extra heavy duty anti-friction ball or spherical roller type selected for an L10 life of 200,000 hours at design operating conditions. Bearings are to be mounted on the integral fan scroll bracing. (Provide an easily removable 24” x 24” access panel in the unit casing adjacent to the motor side bearing for ease of fan shaft/bearing replacement).

.4 Fan and motor shall be mounted on an all welded, structural steel, prime coated and internal isolation base. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible connection. The internally mounted motor shall be provided on a slide rail base to allow proper adjustment of belt tension.

.5 Provide an OSHA approved fully enclosed metal belt guard having side of galvanized steel and expanded metal face. Belt guard shall be sized to allow either sheave to be increased by two sizes.

.6 Provide fixed pitch sheaves rated at 150% of motor nameplate H.P. Allow for one (1) drive change for air balancing purposes (parts only, labour by air balancer).

.7 On air handling units with variable speed drives, mount the VSD on the unit. Factory wire between the VSD and fan motors. Ensure all casing penetrations are sealed to be air tight. Provide a terminal block within the VSD for field termination of line side wiring.

.8 Provide plenum fan inlets on the fan wall and air outlets from the casing with a smooth bellmouth fitting with radius to match casing thickness, and free of protruding structural members and flanges.

.9 Plenum fan assembly must have an enclosed safety screen as per OSHA Standards.

.10 Provide I beam hoist rail above fan section access doors to remove motors 25hp and above. An extendable arm shall also be provided to transport the motor to the unit exterior.

2.8 CENTRAL FUME HOOD EXHAUST FAN (FH-EF-1)

.1 This fume hood exhaust module shall have special construction so as to be suitable for corrosive contaminants in the exhaust air stream.

.2 All fans shall have a Lorenized coating. The fans shall be single width single inlet where the motors are outside the airstream.

.3 Fans shall be capable of isolation from each other with fully actuated isolation dampers (backdraft dampers are not acceptable).

.4 Fan shall be provided as specified in this section and designed to AMCA A spark resistant construction.

.5 Casing, insulation, and access doors for housing containing fans to be provided as specified in this section.

.6 Fan to be supplied complete with self-supporting stacks with heights as indicated on drawings.

.7 Stacks to terminate complete with dilution nozzle

.1 Fans shall incorporate a double concentric accelerator fiberglass reinforced plastic (FRP) induction nozzle selected for optimal performance per the plans and specifications. Nozzle shall be constructed and designed to avoid extreme variations in velocity flows across the outlet, even against wind loading. Where required, CFD shall be provided demonstrating this on submitted nozzle. Bifurcated designs shall not be allowed

.2 Induction nozzle shall be constructed and designed to efficiently handle up to 7000 feet per minute outlet velocity and shall have a optimally matched accelerator for the specified design conditions.

.3 Design to withstand 125mph winds

.8 Fan to be complete with heat recovery coil (for future connection)

.1 Fan to be complete with 6 row heat extraction coil

.2 Provide four coils, each at 900 mm x 2500 mm (36” x 100”)

.3 Maximum velocity across coil not to exceed 2.54 m/s (500 fpm)

.4 Unit to be complete with piping vestibule to enclose heat recovery piping

.9 Fan to be complete with filter section

.1 Provide 50 mm (2”) MERV 8 filters

.2 Provide 21 filters at 600 mm x 600 mm, and 10 filters at 600 mm x 300 mm

.3 Filters to be installed within filter rack as shown on drawings

.10 Fan to be suited for installation on structural support base as indicated on drawings

.11 Provide maintenance platform and steps attached to fan unit as indicated on drawings

.12

2.9 MOTORS

.1 Motors shall be designed for severe duty in accordance with IEEE 841 standards and shall meet NEMA MG1 Part 31. Motors shall be operable at 600 Volts, 60 Hz, 3-phase.

.2 Motor enclosure shall be totally enclosed fan cooled and rated to IP55. A non metallic cooling fan shall be provided. Frame, end bells and fan cowl shall be manufactured of heavy duty cast iron. The end plates shall be sealed to the frame joints. Enclosure shall be epoxy coated and rated for ASTM B117-90 96 hour salt spray test.

.3 Motor windings shall have class F insulation with class B temperature rise ratings. Windings shall be 200C inverter spike resistant wire. Motor windings shall withstand 2000V transients. Motor service factor shall be 1.15 on sine wave power and 1.0 on VFD power.

.4 Bearings shall be regreasable without disassembly and provide for the elimination of purged grease. Bearing life shall be a minimum of L10 at 50000 hours. Bearing seals shall be Inpro or equivalent.

.5 Motors shall be balanced to less than 0.08 inches per second (filter out) and the vibration test data shall be shipped with the motor.

.6 Nameplates shall be stainless steel and contain both NEMA data and bearing data.

.7 Motors used with variable frequency drives shall be provided with a brush system to electrically ground the shaft and discharge any induced voltage on the motor shaft, with a direct path to ground.

.8 Motor shall be provided with a 3 year warranty.

.9 Acceptable motor manufacturers are Reliance-Baldor, US Motors, and TECO-Westinghouse.

2.10 AIRFLOW MEASURING PROBES

.1 Provide on each fan, air flow measuring probes.

.2 Each airflow probe shall contain multiple, averaged velocity pressure taps located symmetrically around the throat of the fan inlet and a single static pressure tap located on the fan housing. The entire airflow monitoring probe must be located outside the inlet throat as to not obstruct airflow.

.3 The probes shall be capable of producing steady, non-pulsating signal of the velocity pressure, independent of the upstream static pressure without adversely affecting the performance of the fan. The sensing probes shall be accurate ±3% of actual fan airflow. The fan inlet sensing rings shall be FreeFlo Sensing Ring as manufactured by Haakon Industries Ltd or Air Monitor Voluprobe.

2.11 AIRFLOW DISPLAY

.1 Provide on indicated fans a method of displaying digitally, in real time, the fans current air flow.

.2 The display shall be capable of showing the airflow of four (4) independent fans simultaneously.

.3 For interaction with a controller, the display shall output one (1) 0-10VDC signal for each fan being monitored.

.4 The output signal shall be accurate to ±0.5% of Natural Span, including non-linearity, hysteresis and non-repeatability.

.5 The display must be water tight allowing for use in outdoor locations. If the display is not water tight it shall be enclosed in a weatherproof housing.

2.12 VIBRATION ISOLATION

.1 An integral all weld steel vibration isolation base shall be provided for the fan and motor.

.2 Provide open spring mounts with iso stiff springs, sound deadening pads and leveling bolts.

.3 Horizontal stiffness shall be equal to vertical stiffness.

.4 Spring deflection shall be 2".

.5 Isolators shall have earthquake restraints. Upon request, the unit manufacturer shall submit a restraint detail certified by a professional engineer.

2.13 COILS

.1 Coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed. Cooling coil racks shall be 12 Ga. 304 stainless steel. Heating coils shall be mounted on galvanized angle racks.

.2 Removable coil access panels shall be provided to remove coils through casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards the access side.

.3 All drain pans shall be double wall continuously welded 304 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 1" down pipes. Condensate drain shall be a minimum 1-1/4" diameter stainless steel tube extending 1" out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.

.4 Coils shall be certified in accordance with ARI Standard 410.

.5 Construction:

.1 Tubes: Horizontal, copper.

.2 Fins: Aluminum mechanically bonded to tubes.

.3 Headers: Seamless copper with vent and drain connections.

.4 Casing: 16 gauge, galvanized steel channels with 16 gauge center and end supports.

.5 Connections: Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing. Roof mounted units shall have the centre of the bottom coil connections located 10” off the unit floor.

.6 Chilled water 5 psig

.7 Hot water 5 psig

.8 Steam Critical pressure

.9 Provide globe valves with stainless steel stems, elastomer U-cup or Teflon rope packing and brass plugs with equal percentage flow characteristics. Acceptable valve manufacturers are Johnson Controls, Honeywell and Siebe.

.10 Provide electric valve actuators of the reversible gear drive type sized to shut off the valve against normal inlet operating pressures. Actuators must be spring return for heating valves. Acceptable actuator manufacturers are Johnson Controls and Belimo.

2.14 DEHUMIDIFIER HEAT PIPE

.1 Unit shall be equipped with Dehumidifier Heat Pipes supplied to precool the return/outside air and reheat the supply air in a wrap-around configuration as indicated on equipment schedules. The precool Heat Pipe module shall be located immediately before the cooling coil and the reheat module of the Heat Pipe shall be located immediately after the cooling coil. Heat pipe circuits shall be made up of multiple tubes feeding one common liquid and one common gas line for maximum performance. Single tube circuits where gas and liquid travel in the same tube in opposite directions are not acceptable. Both Heat Pipe modules shall be inside the equipment cabinet. The interconnecting piping between the Heat Pipe modules shall be located within the assembled access/coil/access sections. All interconnecting piping shall be located at the end of the cooling coil opposite from the coil header and piping connections.

.2 The tubes shall be copper, of specific design for Heat Pipe application, permanently expanded into the fin collars to form firm, rigid, and complete pressure contacts at all operating conditions. Aluminum tubes will not be allowed.

.3 The fin surface shall be continuous plate type aluminum (copper) fins of specific design to produce maximum heat transfer effectiveness for Heat Pipe applications. Airside pressure loss shall be as given on the schedule. Fin density and the number of rows of tubes shall be as specified.

.4 Heat transfer fluid shall be selected on the basis of operating temperature and compatibility with tube material and shall be classified as Safety Group A1 in ASHRAE Standard 34-1992. Do not use HCFC based refrigerants.

.5 Heat Pipe capacities, entering and leaving dry and wet bulb temperatures and face velocity shall be as specified.

.6 The frames and mounting structure shall be minimum 20 gauge galvanized steel. The supply and exhaust air streams shall be isolated from each other by a single separating partition (a double separating partition) (a foam filled double separating partition). Cross contamination between the air streams is not acceptable.

.7 Heat Pipe interconnecting piping and circuitry shall be as specified by manufacturer. Each circuit shall be individually processed, charged, and hermetically sealed.

.8 All of the Dehumidifier Heat Pipe circuits shall be equipped with solenoid operated control valves to control the operation of the Heat Pipe circuits. The solenoid valves shall be wired back to the air handling unit control panel Closing of a valve shall inactivate the Heat Pipe circuit in which it is installed. The valves shall be normally open. The control valves shall be grouped such that each group of valves shall control a designated fraction of the Heat Pipe circuits. With all control valves open, the Dehumidifier Heat Pipe assembly shall operate at full capacity. If all the circuits are equipped with control valves, then closing all the valves will stop all Heat Pipe operation

2.15 PREFILTERS

.1 Prefilters shall be 2"-50mm AM-AIR 300, medium efficiency, pleated, disposable type. The filter shall be listed by Underwriters Laboratories as Class 2.

.2 Prefilters shall be installed in a prefabricated channel rack.

.3 Prefilters shall be lift out from upstream access section.

2.16 FINAL FILTERS

.1 Final filters shall be high performance, AAF deep pleated 12" long cartridge disposable type. Each filter shall consist of glass fibre media, media support grid, contour stabilizer and enclosing frame.

.2 Final filter media shall be of high density microfine glass fibers laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have an average efficiency of 85% on the ASHRAE Test Standard 52. The filter shall be listed by Underwriters Laboratories as Class 2.

.3 Holding frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets and 2 heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lb. pressure without deflection. They will be capable of being attached or removed without the use of tools.

.4 Final filters shall be lift out from upstream access section.

2.17 DRAINS

.1 Provide 1 1/4" capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:

.1 Fresh Air Plenums

.2 Humidifier Sections

.3 Service Corridors

.4 Fan Sections

.5 Sections upstream and downstream of coils

.6 All sections if unit has washdown liner

2.18 LIGHTS

.1 Marine lights with protective cast metal cage and glass globes complete with duplex receptacles shall be installed on the wall across from the access doors. One (1) switch with an indicator light shall be installed on the exterior of the unit. Factory wire from switch to all lights in EMT conduit with liquid tight connections. At all split sections, provide a one foot long piece of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor. Electrical power shall be 120V/1/60.

2.19 FILTER GAUGES

.1 Provide magnehelic gauges.

.2 Magnehelic gauges shall be accurate to +/- 2% of full range.

.3 Provide sensing probes and shut off valves for each gauge.

.4 Provide one gauge flush mounted into the casing for each filter bank.

2.20 ALUMINUM AIRFOIL DAMPERS

.1 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.

.2 Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.

.3 Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.

.4 Bearing shall be designed so that there are no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.

.5 Blade linkage hardware is to be installed in frame out of airstream. All hardware to be on non-corrosive reinforced material or cadmium plated steel.

.6 Damper seals shall be designed for minimum air leakage by means of overlapping seals.

.7 On outdoor air dampers or exhaust air dampers provide internal hollows which are insulated with 7/8" thick polyurethane foam with R factor of 5.0 per inch. Blades shall be 100% thermally broken. Frame shall be insulated with polystyrene, R factor of 5.0 per inch.

.8 Damper blades shall be maximum 40" long per section.

.9 Dampers greater than 2 sections wide shall be provided with a jackshaft.

.10 Acceptable dampers are: T.A. Morrison "TAMCO series 1000" and "RUSKIN CD-50".

2.21 DAMPER OPERATORS

.1 BAS Controls contractor shall supply and install all damper actuators including inside the lab exhaust modules.

.2 Ensure operators are mounted in easily accessible sections of the air handling unit.

2.22 TEST PORTS

.1 Provide 1” diameter test ports for unit air stream testing in each plenum section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing

2.23 STEAM HUMIDIFIERS

.1 Air handling unit manufacturer shall mount steam grid provided by humidifier manufacturer. Balance of steam humidifier components shall be mounted in the field by the contractor. Provide minimum absorption distance downstream of humidifier as scheduled.

.2 Steam supply and drain connections shall be on the same side of the AHU with both pipe connections extended 6” beyond the casing exterior wall at the factory.

2.24 ELECTRICAL

.1 Factory wire and test all air handling units. Have units approved by CSA or ETLc.

.2 Supply one @ 600V/60 Hz/3 Ph power connection for motors and other large electrical devices and one @ 120 V/208V/60 Hz/1 Ph power connection for lights, controls, heaters, etc.

.3 Provide a separate 120 V/ 1 phase feed for a 20 amp convenience outlet.

.4 Provide necessary circuit breakers and/or fuses for each type of electric device.

.5 A bonding wire shall be provided between the motor loads and the electrical panel. Use of the air handling unit casing for a bond will not be accepted.

.6 Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit's service enclosure or on the outside. Ensure the control panel meets the CSA or Canadian Electrical Code (CEC) standard for the specific installation.

.7 Provide a system of motor control including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, auxiliary contactors and terminals for the connection of external control devices or relays. Individually fuse all fan and branch circuits.

.8 Wire from the motors to the motor control in accordance with the local electrical code and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks. At all split sections, provide a 1 foot long piece of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor.

.9 External disconnects shall be provided in a NEMA 4 enclosure for superior water protection. Disconnects must be interlocked with the electrical panels for added personnel safety.

2.25 FIELD ASSEMBLED AIR-HANDLING UNIT

.1 The air-handling unit shall be field assembled on site by the contractor. All parts shall be pre-formed by the manufacturer and partially assembled where access is possible. The parts shall be labeled according to an assembly drawing. All assembly material required such as insulation, sealants, fasteners and hardware shall be supplied by the manufacturer as part of the kit.

.2 Where access permits, sections of the exterior casing shall be pre-assembled in the factory. Otherwise, casing panels shall be shipped individually.

.3 The unit base shall be made in factory-assembled sections with joining flanges for field assembly. The base sections shall be pre-painted and pre-insulated in the factory.

.4 The doors and frames shall be pre-assembled (complete with windows where specified).

.5 Where access permits, the coil and filter racks shall be pre-assembled and pre-painted in the factory.

.6 The fan shall be assembled in the factory complete with motor, protective screening, belt guards and isolation base. The fan and guarding shall be pre-painted in the factory. The fan assembly shall undergo a test run in the factory. Where access permits, the fan assembly shall be shipped in one piece. If access does not permit shipping in one piece, the fan shall be disassembled and shipped in pieces.

.7 The manufacturer shall supply a representative to supervise the assembly of the air-handling unit on the job-site.

.8 The coils shall be installed on site by the contractor.

.9 The air-handling unit shall be finish-painted on site by the contractor.

.10 The electrical panels shall be pre-assembled and pre-tested in the factory. The manufacturer shall provide all necessary conduits and fittings to extend the motor wiring to the electrical panel.

.11 The air-handling unit manufacturer shall provide marine light fixtures, duplex receptacles, the light switch and the necessary conduit and fittings for field installation of the fixtures.

.12 All factory and field wiring and assembly shall be done in accordance with the C.E.C.

.13 The contractor shall be responsible for obtaining electrical approval of the final assembly.

2.26 FINISH

.1 Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, color as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal. Outdoor unit shall be finish coated with polyurethane paint. Paint for outdoor units shall be tested to ATSM B117 for 5000hr salt spray endurance.

2.27 AIR LEAKAGE TESTING

.1 Unit manufacturer shall factory pressure test each air handling unit to ensure the leakage rate of the casing does not exceed 0.5% of the unit airflow at 1.5% of the rated static pressure for 4” thick casing units (1.0% of the unit air flow at 1.5 times the rated static pressure for 2” thick casing units).

.2 Test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure leakage airflow.

.3 The consultant shall witness the pressure test on the first two units. Provide for all transportation for the consultant and owner to the factory.

2.28 SOUND TESTING

.1 Air handling unit sound power levels are not to exceed the levels shown on the equipment schedule.

.2 Furnish sound power levels at supply connection, return connection, outside air opening relief air openings and casing radiation for each air handling unit. Test data shall show sound power levels re 10-12 watts for each of the nine octave band center frequencies.

.3 The air handling unit manufacturer shall be responsible for providing an independent agency to factory test units. The consultant shall witness the sound test on the units. Provide for all transportation for the consultant and owner to the factory.

Part 3 EXECUTION

.1 Install units on a flat surface level within 1/8 inch and of sufficient strength to support the units.

.2 Provide components furnished as per manufacturer's literature.

.3 Provide all water piping so water circuits are serviceable, without having to dismantle excessive lengths of pipe.

.4 Provide valves in water piping upstream and downstream of each coil for isolating the coils for maintenance and to balance and trim the system.

.5 Provide drain valves and vent cocks to each coil.

.6 Provide strainers ahead of all pumps and automatic modulating valves.

.7 Provide certified wiring schematics to the electrical division for the equipment and controls.

.8 Provide all necessary control wiring as recommended by the manufacturer.

.9 Provide condensate traps in accordance with manufacturers recommendations.

.10 Insulate all piping and equipment mounted inside the corridor.

.11 Refer to Custom Indoor Air Handling Units Schedule on Drawings.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 91 13 – Building General commissioning.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)

.1 ANSI/ARI 210/240-2008, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 ARI 270-2009, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL 465-1984, Air Conditioners, Central Cooling.

.3 Canadian Standards Association (CSA)

.1 CSA B52-05 SMART, Mechanical Refrigeration Code.

.2 CSA C22.1 HB-12, Canadian Electrical Code, Handbook.

.4 National Roofing Contractors Association (NRCA)

.5 National Fire Protection Association

.1 NFPA 90A-12, Installation of Air Conditioning and Ventilating Systems.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 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 or 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.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

.2 Indicate:

.1 Brief description of unit, indexed, with details of function, operation, control, and service for components.

.3 Manufacturer's installation instructions shall govern and unless otherwise noted, operation, maintenance and service of items. Include names and addresses of spare part suppliers.

.4 Include following:

.1 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

1.6 WARRANTY

.1 For refrigeration compressors, the 12 months warranty period prescribed in GC3.13 of General Conditions is extended to 5 years.

Part 2 PRODUCTS

2.1 GENERAL

.1 This section applies to RTU-1.

.2 Roof mounted, self-contained single zone unit with gas burner and DX refrigeration and bear label of CSA, FM and ULC.

.3 Units to consist of cabinet and frame, supply fan, heat exchanger, burner control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, gravity exhaust damper.

.4 Prefabricated roof curb to conform to requirements of National Roofing Contractors Association (NRCA), minimum height 450 mm.

.5 Conform to ASHRAE 90.1 - 2010

2.2 CABINET

.1 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to ARI 270, dbA at 3 m free field.

.2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs at top of unit.

.3 Outer casing: weathertight 1.2 mm thick galvanized steel with baked enamel finish, complete with flashing.

.4 Access: gasketted hinged doors or panels with screwdriver operated flush cam type fasteners.

.5 Insulation: neoprene coated glass fiber on surfaces 50 mm thick, 32 kg/m³ density.

2.3 FANS

.1 Centrifugal, forward curved impellers, statically and dynamically balanced. V-belt drive with adjustable variable pitch motor pulley, spring isolated hinge mounted fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators. Vibration isolators: 95% efficiency.

2.4 AIR FILTERS

.1 MERV 8 30% efficiency, metal framed.

.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 steel; secondary heating surface, stainless steel tubes.

.1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.

.2 Induced draft multi-slotted non-clogging cast iron type.

.3 Spark ignited pilot with pilot flame safety shut-off.

2.6 REFRIGERATION

.1 Conform to CSA B52 and ANSI/UL 465 requirements.

.2 Compressor/condenser section:

.1 Hermetic compressor, 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 Fans: propeller type with single piece spun venturi outlets and zinc plated guards. Motor shall be sequenced for head pressure control.

.3 Electrical system shall have operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect.

.4 Include refrigerant piping with, sight glass, filter and valves.

.5 Condenser: staggered copper tube aluminum fin coil assembly with sub-cooling rows.

.3 Evaporator:

.1 Rated to ANSI/ARI 210/240.

.2 Thermostatic expansion valve, with adjustable super heat and external equalizer.

.3 Coil: NPS1/2 od staggered seamless copper tubes expanded into aluminum fins, fins per 25 mm, and insulated condensation pan.

.4 Cooling coil condensate drain pans: designed to avoid standing water, to be easily cleaned or removable for cleaning. Drain connection to have deep seal trap and be complete with trap seal primer.

2.7 ROOF CURB

.1 Provide 350mm insulated roof curb.

2.8 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 Single zone cooling control:

.1 Room thermostat to activate cooling relay in control circuit cycling compressor. Provide safeties and pressure controls. Condenser fans to operate in sequence.

.3 Mixed air single zone unit:

.1 Motorized outside, return and automatic power exhaust gravity relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed.

.2 Tight fitting opposed blade dampers with neoprene or suitable gaskets, bronze bushings and 1% maximum leakage.

.3 Damper operation: 24V, spring return motor with gear train sealed in oil,[and heater for operation under minus 18°C.

.4 Unit to be complete with integral economizer mode.

.4 Night mode: unit cycles as unit heater with 100% recirculation on winter or summer cycles.

.5 Unit to be complete with BACnet controller for integration to building automation system.

2.9 CAPACITY

.1 Refer to schedules

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install as per manufacturers' instructions on roof curbs provided by manufacturer as indicated.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Run drain line from cooling coil condensate drain pan to discharge over roof drain.

3.2 START-UP

.1 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.2 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.

3.3 COMMISSIONING REPORTS

.1 In accordance with Section 01 91 13, supplemented as specified herein.

3.4 TRAINING

.1 In accordance with Section 01 79 00, supplemented as specified herein.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 ASTM International

.1 ASTM E84-12, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM C916-1985(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).

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturer's Instructions: provide to indicate special handling and storage criteria, installation sequence, cleaning procedures and recommended operating conditions.

.4 Shop Drawings:

.1 Indicate on drawings:

.1 Input and output capacity size and quantity of piping connections.

.2 Dimensions, weight, internal and external construction details, recommended method of installation with proposed structural support, sizes and location of mounting bolt holes.

.3 Electrical requirements including voltage, phase, and amperage draw

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect unit heaters 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 and packaging materials as specified in Section 01 74 20.

Part 2 PRODUCTS

2.1 HORIZONTAL UNIT HEATERS

.1 Horizontal Unit Heaters: to UL 2021.

.2 Casing: 1.6 mm thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.

.3 Coils: hydrostatically test to 1 MPa.

.1 Hot water coil: copper tube, mechanically bonded aluminum fins spaced 25 mm maximum rated 1378 kPa minimum working pressure and 104 degrees C maximum entering-water temperature. Include manual air vent and drain.

.2 Steam coil: copper distributing tube, with mechanically bonded aluminum fins spaced 25 mm maximum rated 517 kPa minimum working pressure.

.4 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.

.5 Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor explosion proof supports.

.6 Air outlet: two-way adjustable louvres.

.7 Capacity: as indicated

.8 Thermostat: electronic type, in water resistant enclosure as indicated on drawings.

2.2 ELECTRIC UNIT HEATERS

.1 20 gauge steel, complete with adjustable louver and high limit temperature control with automatic reset.

.2 Fan shall be complete with thermally protected motor.

.3 Heating elements shall be tubular type, stainless steel finned.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that site conditions are acceptable for unit heaters installation in accordance with manufacturer's written instructions.

.1 Visually inspect area where unit heaters are to be installed.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Include double swing pipe joints as indicated.

.3 Check final location with Departmental Representative if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.4 Water units: for each unit, install gate valve on inlet and calibrated balancing valve on outlet of each unit. Install drain valve at low point.

.1 Install manual air vent at high point.

.5 Steam units: for each unit, install gate valve on inlet, steam trap assembly as indicated on outlet.

.6 Clean finned tubes and comb straight.

.7 Provide supplementary suspension steel as required.

.8 Install thermostats in locations indicated.

.9 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by unit heaters installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.2 Underwriter's Laboratories of Canada (ULC)

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Indicate following:

.1 Input heating requirements.

.2 Output steam capacity

.3 Minimum absorption distance

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Fold up metal banding, flatten and place in designated area for recycling.

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.

1.6 MANUFACTURED ITEMS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

Part 2 PRODUCTS

2.1 GAS TO STEAM TYPE (WTC)

.1 Provide an evaporative humidifier that uses natural gas to create steam for humidification through the use of a heat exchanger.

.2 Humidifier shall be CSA and CGA approved

.3 Provide two pass, indirect fired heat exchanger, hot surface ignition, forced draft fully modulating (input turndown ratio of 4:1 with time proportioning below that threshold) natural gas burner and heat exchanger.

.4 Provide a pressure switch on the flue gas vent to detect obstruction and shut down the unit.

.5 Provide standard size flue vent corrections.

.6 Heat exchangers shall be self cleaning.

.7 Provide backup low water cutout.

.8 Provide a temperature sensor above the burner to shut down the unit if excessive temperature occurs

.9 System shall consist of a microprocessor mounted and wired in the control cabinet and a modulating duct mounted transmitter having an operating range of 20% to 80% R.H., shipped loose for field mounting.

.10 The system shall modulate the humidifier output from 0% to 100% of maximum capacity.

.11 Humidifiers shall be a Category I approved appliance certified for “B” vent chimney applications.

.12 Type “B” venting shall consist of double wall construction with an aluminum inner liner and a galvanized steel exterior jacket.

.13 Provide sealed combustion to allow air for combustion to be mechanically induced from outside the building via dedicated piping to a PVC or CPVC connection.

.14 Capacity:

.1 As indicated on drawings.

.15 Controls: As indicated on drawings and Division 25 specifications.

2.2 STEAM TO STEAM TYPE

.1 Provide an evaporative humidifier that uses steam from a boiler to create steam for humidification through the use of a heat exchanger.

.2 Humidifier shall be ETL and C-ETL certified.

.3 Heat exchanger shall be constructed of an electroless nickel coated copper to allow continuous shedding of scale.

.4 Steam valve shall be a normally closed modulating type with modified linear flow characteristics, stainless steel trim and actuator.

.5 Provide a float and thermostatic condensate steam trap and a steam supply line strainer.

.6 System shall consist of a microprocessor mounted and wired in the control cabinet and a duct mounted transmitter having an operating range of 20% to 80% R.H., shipped loose for field mounting.

.7 The system shall modulate the humidifier output from 0% to 100% of maximum capacity

.8 Capacity:

.1 As indicated on drawings.

.9 Controls: As indicated on drawings and Division 25 specifications.

2.3 STEAM DISTRIBUTION

.1 Hose and Tube Kits

.1 Furnish and install where indicated on the drawings hose and tube kits.

.2 Each kit shall consist of one ten foot section reinforced vapor hose, two stainless steel hose clamps, a two-piece escutcheon plate and one 304 stainless steel duct dispersion tube of length that will span the width of the duct.

.3 Duct tube shall be fitted with row of high temperature thermoplastic tubelets arranged to discharge the steam vertically.

.4 Each tubelet shall extend through the dispersion tube and incorporate a properly sized calibrated orifice.

.5 Dispersion tube shall have a 12 mm condensate drain when capacity exceeds 30 lbs per tube/per hour.

.6 Tube and hose sizes shall be as scheduled

.2 Tube Bank

.1 Furnish and install where indicated and of component sizes noted on the drawings tube banks.

.2 Tube bank shall consist of a horizontal header/separator and designated quantity of vertical dispersion tubes necessary to achieve the required steam capacity and absorption distance.

.3 Header and dispersion tubes shall be 316 stainless steel.

.4 Header/separator shall span the width of the duct and be fitted with nipples for dispersion tube connections.

.5 The dispersion tubes shall extend the height of the duct and shall be fitted with two rows of tubelets centered on the diametric line and spaced 37mm apart.

.6 These tubelets shall be made of non-metallic material designed for steam temperatures.

.7 Each tubelet shall extend through the wall of and into the center of the dispersion tube and incorporate a properly sized calibrated orifice

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Install humidistat as indicated.

.3 Water service overflow drain: as indicated.

.4 Install access doors or panels in adjacent ducting.

.5 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.

.6 Install capped drain connection at low point in duct.

3.2 START-UP

.1 General: In accordance with Section 01 91 13: General Requirements, supplemented as specified herein.

.2 Verify:

.1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.

.2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.

.3 Visually check distribution manifold to ensure:

.1 Even distribution of vapour.

.2 Freedom from water deposits.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General: In accordance with Section 01 91 13: General Requirements, supplemented as specified herein.

.2 Application tolerances:

.1 Steam output capacity.

.3 Timing:

.1 After TAB of ducted air systems.

.2 At same time as PV of related air handling units.

.4 PV procedures:

.1 Gas to Steam and Steam to Steam type:

.1 Verify performance in accordance with manufacturer’s startup checklist.

3.4 REPORTS

.1 General: In accordance with Section 01 91 13: Reports, supplemented as specified herein.

.2 Include:

.1 PV results on approved PV Report Forms.

.2 Product Information Report Forms.

3.5 TRAINING

.1 Refer to Section 01 91 13: Training of O&M Personnel.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This section includes the requirements for variable frequency drives (VFD).

.2 Scope of work is to provide variable frequency drives complete with controls for equipment as identified in the motor schedule.

.3 Coordination with Contractor, delivery dates, equipment start up and technical support for the installing contractor.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.2 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

.3 Canadian Standards Association (CSA):

.1 CSA C22.1-09, Canadian Electrical Code, Part I (21st Edition), Safety Standard for Electrical Installations

.2 CAN3 Z299.3-85 (R2006), Quality Assurance Program - Category 3

.4 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG2-2007 Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

.2 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 DESIGN REQUIREMENTS

.1 Design adjustable frequency controller to operate standard squirrel cage induction motor with a 1.15 SF; with harmonic loading not exceeding a motor service factor of 1.0.

1.4 QUALITY ASSURANCE

.1 Factory Testing:

.1 VFD units are to be factory tested, including a full load heat run test, prior to shipment.

.2 Provide certified copies of production test results required by CSA and NEMA, prior to acceptance of the equipment.

.2 Field Testing:

.1 The VFD supplier shall provide onsite start-up, fine tuning, commissioning and operator training.

.2 Allow for all costs and labour for as many trips as necessary to complete requirements.

.3 Conduct harmonic analysis of VFD units upon completion of fine tuning and commissioning phase of the installation for both input and output voltages and current. The harmonic analysis is to be conducted at 50%, 75% and 100% speed under normal load conditions and perform a Fourier (FFT) transform analysis spectrum for each waveform covering the fundamental to the 50th harmonic for each VFD on this project.

.4 Should the waveform analysis indicate that either the input or output voltage and current levels exceed NEMA Standard for electric motors and IEEE 519, the VFD supplier shall provide all the necessary line filtering equipment to correct the harmonic distortion. The VFD supplier shall include all associated costs for line filtering equipment in the tender price.

.3 Provide certified copies of all production test results required by CSA and NEMA.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 30 00 – Administrative Requirements.

.2 Full shop drawings of all equipment to be submitted for review prior to manufacture.

.3 Provide as built shop drawings for each unit upon completion of installation.

Part 2 Products

2.1 GENERAL

.1 Variable speed controller shall be electronic adjustable frequency and voltage output unit. The variable frequency drive shall be PWM type. All units shall be CSA approved and manufactured to CSA Z299.3.

.2 The drive shall be rated for continuous duty while operating a NEMA design induction motor of the sizes and operating voltages as shown in the following schedules and indicated on the drawings. Drive output shall be sized for a 1.15 motor service factor.

.1 The VFD shall have a current rating at least 10% in excess of the motor full load amp rating. An overload service factor of 110% for thirty minutes or 150% for one minute duty must be supplied to ensure adequate safety margins.

.3 The VFD shall have a fixed bridge type converter (PWM) with a minimum of a 98% input displacement power factor over a 10 to 100% speed range. The efficiency shall be a minimum of 97% for all inverters when operated at full speed and load.

.4 Input voltage shall be as indicated on motor schedules and drawings, line voltage variation 10% Line frequency variation ±5%. Vary output voltage with motor speed to nominal motor voltage. Modulate output speed through a 10:1 range. Speed stability shall be ±1%. Drive shall match torque characteristic of load.

.5 Input frequency setting signal will be an isolated 4 to 20 mA DC. Output speed monitoring signal shall be galvanic isolated 4 to 20 mA DC. The VFD shall come with An integral BTL (BACnet Testing Laboratory) certified interface controller.

.6 Provide drive with individual NEMA Type 1 enclosure, drip proof suitable for wall or free standing installation. Forced air cooled enclosures shall have filters on all air inlet openings. Filter media is to be chemical treated.

.7 Protective devices to be incorporated are:

.1 3 pole MCB to provide overcurrent protection set at not more than 150% of drive input rating for a given motor size. Molded case breaker shall have 25 kA IC symmetrical rating to be coordinated with drive's electronic protection circuits. Circuit Breaker to have lock-off facilities. Confirm IC symmetrical rating as noted on drawings.

.2 Fast acting electronic circuit board protective fuses for protection of electronic components.

.3 Line filter in the drive input to protect electronic components from transient voltage conditions.

.4 Integral electronic motor overload protection adjustable up to 150% of motor rating for 60 seconds.

.5 Overcurrent instantaneous trip 250%.

.6 Short-circuit protection.

.7 Ground fault protection.

.8 Overvoltage DC bus monitor/protection.

.9 Undervoltage protection.

.10 Loss of phase and phase unbalance protection.

.11 Inverter over-temperature protection.

.12 Capable of running without motor.

.13 Output filter package to limit motor voltage to 1200 volts maximum, at motor terminals.

.14 Long lead (motor feeder) filter package.

.15 Thermister relay(s) as required.

.16 BACnet Compatibility.

.8 Operation Features:

.1 Regenerative braking.

.2 Fault shutdown.

.3 Automatic restart following power outage.

.4 Ability to disconnect motor load for setup or trouble.

.5 Manual speed control potentiometer.

.6 Adjustable maximum and minimum speed.

.7 Acceleration and deceleration time adjustment.

.8 Controller "stop" interlock from a NC dry contact.

.9 Hand/Off/Auto selection switch or key pad.

.10 Drive fault contact (Form C).

.11 Stop/start push buttons or key pad.

.12 Transient voltage protection.

.13 Provide seven (7) dry "c" type contacts programmable for any combination of the following:

.1 Running (output frequency being generated).

.2 Fault lockout.

.3 Stopped.
.4 Overspeed.
.5 At speed.
.6 Under speed.
.7 Forward/Reverse.
.8 Low reference.
.9 Manual/Auto Mode.
.10 Local/Remote Mode.

.14 Soft Start sequence.

.9 Environmental capabilities: The drive shall operate without mechanical or electrical damage under any combination of conditions as follows:

.1 Ambient temperature -0° to 40°C.
.2 Humidity 0 to 90% (non condensing).
.3 Vibration up to 0.5 G.
.4 Altitude 0 to 1000 m.

.10 Diagnostic and indicating features:

.1 Power ON indication.
.2 Percentage speed indicator.
.3 Overload indication.
.4 Short circuit indication.
.5 Ground fault indication.
.6 Overvoltage indication.
.7 Undervoltage indication.
.8 High temperature (controller).
.9 AC voltmeter (output).
.10 AC ammeter (output).
.11 Inverter ready.
.12 Inverter fault.
.13 External fault.

.11 Cooling System:

.1 VFD Supplier to provide adequate cooling devices for VFD equipment.

.12 Emergency Distribution:

.1 The VFD may be supplied from an emergency distribution system which is subjected to a short power interruptions during test of the emergency generator system. The VFD shall be designed to continuously operate through this test mode.

.2 VFD suppliers shall verify that this condition will not cause damage to their equipment and that they will be able to ride-through this disturbance without any operational shutdowns.

.13 Control wiring shall be TEW 105°C rise.

.14 Terminal blocks for remote interface.

.15 Provide wire markers at both ends of all control wires.

.16 Note that shop drawings must clearly indicate all standard and optional features allowed for in this specification.

.17 Drive components to be flush mounted in free-standing enclosure, front cover includes:

.1 Disconnect operator.

.2 Power ON indicator.

.3 Percent speed indicator.

.4 Selector switch (HOA) or key pad entry.

.5 Manual speed adjust potentiometer or key pad entry.

.6 Fault indicator.

.18 Maintenance

.1 VFD supplier shall provide four copies of operation and maintenance manuals.

.2 Operation and maintenance manuals are to include a list of authorized service depots, spare parts lists and recommended spare parts.

.3 VFD supplier is to include a preventative maintenance program (PMP) for a one year period. The PMP is to be broken down to daily, weekly, monthly and annual service periods. Each service period is to include all manufacturer recommended maintenance tasks which should be completed in each period. A maintenance check list is to be cross referenced to the maintenance period and maintenance task.

.19 Warranty

.1 The VFD supplier shall provide warranty coverage for a period of twelve (12) months upon the contractor being granted Final Acceptance and the warranty period has commenced.

.2 VFD supplier shall be responsible for all costs during the warranty period for materials, design, labour and installation costs for installation of harmonic, EMI or RFI filters required to prevent interference to any other equipment on the project which is caused by the operation of the VFD's.

.3 VFD supplier shall be responsible for electric motor failures costs such as rewinding, replacement, labour and expenses for electric motors which fail after they have been terminated to a VFD during the warranty period.

Part 3 Execution

3.1 GENERAL

.1 The Contractor will provide the VFD manufacturer an as built of each motor application. Motor application data will include the following:

.1 Motor Manufacturer.

.2 Class.

.3 Motor Model Number.

.4 Motor Serial Number.

.5 Motor Frame.

.6 Motor H.P. (KW).

.7 Motor F.L.A.

.8 Motor Conductor Size.

.9 Ground Conductor.

.10 Length of Conductors from MCL to Motor.

.11 MCC Manufacturer.

.12 Motor MCP and Overload.

3.2 INSTALLATION

.1 Division 26 - Electrical shall extend all load side wiring from the source to the drive; in addition, Electrical shall extend all line side wiring from the drive to the driven load.

.2 Division 23 - Mechanical shall be responsible for complete commissioning of each variable speed drive to satisfaction of the consultant. Division 23 - Mechanical shall allow for factory representative to completely calibrate all drive circuits after installation on site.

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 Sections.

.1 Section 01 91 13 - Commissioning.

.2 Section 01 79 00 - Demonstration and Training.

.3 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01.

.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 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.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 Representative before 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.

.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.

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 and as per the commissioning plan.

.2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative and PWGSC Commissioning Manager.

.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 [and PWGSC Commissioning Manager].

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 and Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Commissioning Manager and Departmental Representative.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

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 VAV supply duct SP transmitters.

.3 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 [and to [BECC]].

.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 PWGSC 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 and Departmental Representative 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 and Departmental Representative 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 and section 01 91 13.

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.

.2 Related Sections.

.1 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

.2 For additional acronyms and definitions refer to Section 25 05 01.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00, 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 competent instructors thoroughly familiar with aspects of EMCS installed in facility.

.2 Departmental 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 INSTRUCTION

.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: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative and PWGSC Commissioning Manager.

.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: 5 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 2 days training within 5 day period in following subjects in approximate percentages of total course shown:
Software abd architecture: 10%
Application programs: 15%
Controller programming: 50%
Trouble shooting and debugging:10%
Colour graphic generation: 15%

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 Related Sections:

.1 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Section 25 05 54 - EMCS: Identification.

.3 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

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.

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 and local UPS to all field and master control panels.
- .5 Metric references: in accordance with CAN/CSA Z234.1.
- .6 All wiring to be run in conduits, refer to division 26 for conduit requirements.
- .7 All low voltage wiring shall be supplied and installed by Division 25. All line voltage wiring shall be supplied and installed by Division 26.

.4 Language Operating Requirements:

- .1 Provide English operator selectable access codes.
- .2 Use non-linguistic symbols for displays on graphic terminals. Other information to be in English.
- .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
- .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English:

.1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in [French] [and] [English] at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 and 25 05 02.

.2 Submit for review:

.1 List existing field control devices to be re-used within 60 days of 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. 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 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

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 and recycling in accordance with Section 01 74 20.

.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, Plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.

.7 Label location of salvaged material's storage areas and provide barriers and security devices.

.8 Ensure emptied containers are sealed and stored safely.

.9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

.10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.9 EXISTING CONTROLS SYSTEM

.1 The existing control system is a Delta Controls System. Existing controllers are located through-out the facility

.2 As part of this project the contractor shall provide a control system fully integrated into and compatible with the existing system. All new controls points shall communicate seamlessly with the existing system.

.3 The existing graphic interface on the existing operator work station shall be updated to reflect all new control points and parameter.

.4 New alarm points and schedules shall be visible, annunciated and modified via the existing controls interface.

1.10 EXISTING CONDITIONS - CONTROL COMPONENTS

.1 Replace all existing control and devices.

.2 Replace all field control devices.

.1 Do not modify original design of existing devices without written permission from Departmental Representative.

.2 Provide for new, properly designed device where re-usability of components is uncertain.

.3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.

.1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.

.2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.

.1 Be responsible for items repaired or replaced by Departmental Representative.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 PRODUCTS

2.1 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: ASHRAE STD 135.

.2 Complete list of equipment and materials to be used on project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.2 ADAPTORS

.1 Provide adaptors between metric and imperial components.

Part 3 EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 PAINTING

.1 Painting: in accordance with Section 09 91 23, supplemented as follows:

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

.4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

3.3 FIELD QUALITY CONTROL

.1 Verification requirements 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).

.2 Related Sections.

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of 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.

.13 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 and coordinate with requirements in this Section.

.2 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.3 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.

.4 Soft copy to be in PDF format, structured using menu format for easy loading and retrieval on OWS.

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, signal levels, pressures where new EMCS ties into existing control equipment.

.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 DETAIL 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.

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.

.2 Related Sections.

.1 Section 01 78 00 - Closeout Submittals.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 02 - EMCS: Submittals and Review Process.

.4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 78 00, supplemented and modified by requirements of this Section.

.2 Submit As-built drawings, Operation and Maintenance Manual 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 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.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Departmental Representative.

.3 Provide before acceptance 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 3 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 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.

.2 Related Sections.

.1 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-09, The Canadian Electrical Code, Part I (21st Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01.

1.4 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 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 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 chain.

.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 including motors, 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.

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 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 Sections.

.1 Section 25 05 01 - EMCS: General Requirements.

.3 References.

.1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.

.2 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.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.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.

.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 "As-built 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 2 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.

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 and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and 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 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).

.2 Related Sections:

.1 Section 25 05 01 - EMCS: General Requirements.

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 802.3TM -2002, 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.

1.4 SYSTEM DESCRIPTION

.1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568 and CSA T530 TIA/EIA-569-A and TBITS 6.9.

.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 Modems.

.3 Network interface cards.

.4 Network management hardware and software.

.5 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 existing OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.

.2 EMCS-LAN to: BACnet, Proprietary Protocol.

.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.

.3 Network Medium.

.1 Network medium: compatible with network protocol to be used within buildings.

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 Related Sections:

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .3 Section 25 05 03 - EMCS: Project Record Documents.
- .4 Section 25 30 02 - EMCS: Field Control Devices.
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

- .1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).

- .1 CSA C22.2 No.205-M1983(R2009), 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.

1.4 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

- .1 Provide sufficient controllers to meet intents and requirements of this section.
- .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

- .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.

.1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.

.2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

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- 20mA;

.2 0 - 10V 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 220V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0°C to 44°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 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 and Section 25 05 02.

.1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03.

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.

.5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01.

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.

.2 Modify setpoints.

.3 Modify PID loop parameters.

.4 Override PID control.

.5 Change time/date.

.6 Add/modify/start/stop weekly scheduling.

.7 Add/modify setpoint weekly scheduling.

.8 Enter temporary override schedules.

.9 Define holiday schedules.

.10 View analog limits.

.11 Enter/modify analog warning limits.

.12 Enter/modify analog alarm limits.

.13 Enter/modify analog differentials.

.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

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 2interface 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.

.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 PWGSC point naming convention as defined in Section 25 05 01.

Part 3 EXECUTION

3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as directed by Departmental Representative.

.2 Provide necessary power from local 120 V 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 SUMMARY

.1 Related Sections:

- .1 Section 07 84 00 - Firestopping.
- .2 Section 23 33 15 - Dampers - Operating.
- .3 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .4 Section 25 05 01 - EMCS: General Requirements.
- .5 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .6 Section 25 05 54 - EMCS: Identification.
- .7 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- .8 Section 26 05 01 - Common Work Results - Electrical.
- .9 Section 26 27 10 - Modular Wiring System.
- .10 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

- .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
- .2 ANSI/IEEE C57.13-08, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).

- .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).

- .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).

- .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).

- .1 CAN/CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01.

1.4 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02.

.2 Pre-Installation Tests.

.1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Section 01 73 03 supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work.

.3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 PRODUCTS

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.

.3 Operating conditions: 0 - 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01.

2.2 TEMPERATURE SENSORS

.1 General: except for room sensors to be resistance or thermocouple type to following requirements:

.1 Thermocouples: limit to temperature range of 200 °C and over.

.2 RTD's: 100 or 1000 ohm at 0°C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385ohms/ohm °C.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 °C.

.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 150 mm as indicated.

.2 Room temperature sensors and display wall modules.

.1 For Lab spaces refer to section 23 36 00 Air Terminal Units.

.2 Temperature sensing and display wall module.

.1 LCD display to show space temperature ed and temperature setpoint.

.2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.

.3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit for access to zone bus.

.4 Integral thermistor sensing element 10,000 ohm at 24 °.

.5 Accuracy 0.2°C over range of 0 to 70°C.

.6 Stability 0.02°C drift per year.

.7 Separate mounting base for ease of installation.

.3 Room temperature sensors (public corridors and mechanical rooms).

.1 Wall mounting, in slotted type covers having brushed aluminum brushed stainless steel finish, with guard as indicated.

.2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 °C.

.3 Duct temperature sensors:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm.

.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.4 Outdoor air temperature sensors:

.1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 °C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 °C per volt change.

.3 Output signal: 4 - 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50 °C.

.10 Long term output drift: not to exceed 0.25% of full scale/ 6 months.

.11 Transmitter ranges: select narrowest range to suit application from following:

.1 Minus 50 °C to plus 50 °C, plus or minus 0.5 °C.

.2 0 to 100 °C, plus or minus 0.5 °C.

.3 0 to 50 °C, plus or minus 0.25 °C.

.4 0 to 25 °C, plus or minus 0.1 °C.

.5 10 to 35 °C, plus or minus 0.25 °C.

2.4 HUMIDITY SENSORS

.1 Room and Duct Requirements:

.1 Range: 5 - 90% RH minimum.

.2 Operating temperature range: 0 - 60 °C.

.3 Absolute accuracy:

.1 Duct sensors: plus or minus 3%.

.2 Room sensors: plus or minus 2%.

.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.

.5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.

.6 Room sensors: locate in air stream near RA grille or wall mounted as indicated.

.7 Duct mounted sensors: locate so that sensing element is in air flow in duct.

.2 Outdoor Humidity Requirements:

.1 Range: 0 - 100% RH minimum.

.2 Operating temperature range: -40 - 50 °C.

.3 Absolute accuracy: plus or minus 2%.

.4 Temperature coefficient: plus or minus 0.03%RH/ °C over 0 to 50°C.

.5 Must be unaffected by condensation or 100% saturation.

.6 No routine maintenance or calibration is required.

2.5 HUMIDITY TRANSMITTERS

.1 Requirements:

.1 Input signal: from RH sensor.

.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.

.3 Input and output short circuit and open circuit protection.

.4 Output variations: not to exceed 0.2% of full scale output for supply voltage variations of plus or minus 10%.

.5 Output linearity error: plus or minus 1.0% maximum of full scale output.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 1.0% full scale/ 6 months.

.8 Long term output drift: not to exceed 0.25% of full scale output/ 6 months.

2.6 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.

.5 Temperature effects: not to exceed plus or minus 1.5% full scale/ 50 °C.

.6 Over-pressure input protection to at least twice rated input pressure.

.7 Output short circuit and open circuit protection.

.8 Accuracy: plus or minus 1% of Full Scale.

2.7 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5% full scale/50 °C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 STATIC PRESSURE SENSORS

.1 Requirements:

.1 Multipoint element with self-averaging manifold.

.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).

.2 Accuracy: plus or minus 1% of actual duct static pressure.

2.9 STATIC PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 150% of duct static pressure at maximum flow.

.3 Accuracy: 0.4% of span.

.4 Repeatability: within 0.5% of output.

.5 Linearity: within 1.5% of span.

.6 Deadband or hysteresis: 0.1% of span.

.7 External exposed zero and span adjustment.

.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.10 VELOCITY PRESSURE SENSORS

.1 Requirements:

.1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.

.2 Maximum pressure loss: 37 Pa at 1000 m/s.

.3 Accuracy: plus or minus 1% of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 125% of duct velocity pressure at maximum flow.

.3 Accuracy: 0.4% of span.

.4 Repeatability: within 0.1% of output.

.5 Linearity: within 0.5% of span.

.6 Deadband or hysteresis: 0.1% of span.

.7 External exposed zero and span adjustment.

.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.12 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated 24 V DC.

.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2% repetitive switching.

.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.13 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 High temperature detection: manual reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 °C.

.4 Snap action rating: 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Duct, general purpose: insertion length = 460 mm.

.2 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.3 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.4 Strap-on: with helical screw stainless steel clamp.

2.14 SOLENOID CONTROL AIR VALVES

.1 Coil: 24V DC.

.2 Capacity: to pass a minimum of 0.15 l/s air at 140 kPa differential.

2.15 AIR PRESSURE GAUGES

.1 Diameter: 38 mm minimum.

.2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

2.16 ELECTROMECHANICAL RELAYS

.1 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120 V AC.

.4 Relay to have visual status indication

2.17 SOLID STATE RELAYS

.1 General:

.1 Relays to be socket or rail mounted.

.2 Relays to have LED Indicator.

.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.

.4 Operating temperature range to be -20°C to 70°C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25°C for 1 second maximum duration.

.7 Operational frequency range, 45 to 65 HZ.

.2 Input:

.1 Control voltage, 3 to 32 VDC.

.2 Drop out voltage, 1.2 VDC.

.3 Maximum input current to match AO (Analog Output) board.

.3 Output.

.1 AC or DC Output Model to suit application.

2.18 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.19 CURRENT SENSING RELAYS

.1 Requirements:

.1 Suitable to detect belt loss or motor failure.

.2 Trip point adjustment, output status LED.

.3 Split core for easy mounting.

.4 Induced sensor power.

.5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.

.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.

.7 Adjustable latch level.

2.20 CONTROL DAMPERS

.1 Refer to section 23 33 15.

2.21 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Requirements:

.1 Direct mount proportional type as indicated.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.

.4 Power requirements: 5 VA maximum at 24 V AC.

.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.

.6 For VAV box applications floating control type actuators may be used.

.7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.22 CONTROL VALVES

.1 Body: characterized ball.

.1 Flow characteristic as indicated on control valve schedule: equal percentage, quick opening.

.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.3 Normally open for heating and Normally closed for cooling.

.4 Two and Three port, as indicated.

.5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.6 Packing easily replaceable.

.7 Stem, stainless steel.

.8 Plug and seat, stainless steel.

.9 Disc, replaceable , material to suit application.

.10 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Rangeability 50:1 minimum.

.11 NPS 2½ and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

.2 Butterfly Valves NPS 2 and larger:

.1 Body: for chilled water ANSI Class 150 cast iron lugged body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body.

.2 End connections to suit flanges that are ANSI Class 150.

.3 Extended stem neck to provide adequate clearance for flanges and insulation.

.4 Pressure limit: bubble tight sealing to 170 kilopascals.

.5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B 148.

.6 Seat: for service on chilled water PTFE (polytetrafluoroethylene).

.7 Stem: 316 stainless steel.

.8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.9 Flow characteristic linear.

.10 Maximum flow requirement as indicated on control valve schedule.

.11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.

.12 Normally open for heating and Normally closed for cooling.

.13 Valves are to be provided complete with mounting plate for installation of actuators.

2.23 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signal: 0-10V DC or 4-20 mA DC.

.3 Positioning time: to suit application. 90 sec maximum.

.4 Fail to normal position as indicated.

.5 Scale or dial indication of actual control valve position.

.6 Size actuator to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.8 Minimum shut-off pressure: refer to control valve schedule.

2.24 PANELS

.1 wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.

.3 Panels to be lockable with same key.

2.25 WIRING

.1 In accordance with Division 26.

.2 All wiring to run in conduit.

.3 Wiring must be continuous without joints.

.4 Sizes:

.1 Field wiring to digital device: 20AWG stranded twisted pair.

.2 Analog input and output: shielded #20 minimum stranded twisted pair.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Division 21.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

.7 Mechanical: supply and install in accordance with Section 23 09 43.

.1 Pipe Taps.

.2 Wells and Control Valves.

.3 Air flow stations, dampers, and other devices.

.8 VAV Terminal Units: supply, install and adjust as required.

.1 Air probe, actuator and associated VAV controls.

.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.

.3 Co-ordinate air flow adjustments with balancing trade.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.4 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

.2 Wire multiple sensors in series for low temperature protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use software averaging algorithm to derive overall average for control purposes.

.6 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 MAGNEHELIC PRESSURE INDICATORS

.1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.

.2 Locations: as specified.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.7 AIR PRESSURE GAUGES

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.8 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54.

3.9 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2 REFERENCES

.1 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 SEQUENCING

.1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.

.2 Sequencing of operations for system[s] as follows:

.1 Refer to mechanical drawings, M6.xx series.

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 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.

.2 Reference Standards:

.1 CSA Group

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 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.

.2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4 Submit drawings and product data to inspection authorities.

.5 If changes are required, notify Departmental Representative of these changes before they are made.

.4 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 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.

.5 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 CONTROL.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.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.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 20.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 20.

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 and labels 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.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction 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 26 05 34 except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as indicated on mechanical drawings.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction, inspection authorities and Departmental Representative.

.2 Decal signs, minimum size 175 x 250 mm.

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 and labels as follows:

.1 Nameplates: lamicoid, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Nameplates for Critical Power Panels: same as above, except with blue lamicoid

.3 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 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. [_____]" as directed by Departmental Representative.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, 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.

.4 Use colour coded wires in communication cables, matched throughout system.

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
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

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.

2.10 SERVICE INTERRUPTIONS

.1 Coordinate all service interruptions in advance with the Departmental Representative, in accordance with 01 14 00 Work Restrictions and provide:

.1 List of all scheduled interruptions

.2 Areas and equipment affected by each interruption

.3 Duration of each interruption

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 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

.1 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 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.

.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 and elevator machine rooms on latch side of floor.

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 Local switches: 1200 mm.

.2 Wall receptacles:

.1 General: 400 mm.

.2 Above top of continuous baseboard heater: 200 mm.

.3 Above top of counters or counter splash backs: 175 mm.

.4 In mechanical rooms: 1200 mm.

.5 TV height: 1600mm.

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and interphone outlets: 400 mm.

.5 Wall mounted telephone and interphone outlets: 1200 mm.

.6 Fire alarm stations: 1200 mm.

.7 Fire alarm bells: 2100 mm.

.8 Television outlets: 400 mm.

.9 Wall mounted speakers: 2100 mm.

.10 Clocks: 2100 mm.

.11 Door bell pushbuttons: 1200 mm.

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 (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers 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.

.1 Circuits originating from branch distribution panels.

.2 Lighting and its control.

.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.4 Systems: fire alarm, communications.

.5 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Departmental Representative.

.4 Provide instruments, meters, 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 - 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.

3.9 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.18.1-13, Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX- J-023/1).

.2 CAN/CSA-C22.2 No.18.2-06(R2011), Nonmetallic Outlet Boxes.

.3 CSA C22.2 No.18.3-12, Conduit, tubing, and cable fittings (Tri-national standard, with ANCE NMX-J-017 and UL 514B).

.4 CAN/CSA-C22.2 No.18.4-15, Hardware for the Support of Conduit, Tubing, and Cable (Bi-National standard, with UL 2239).

.5 CSA C22.2 No. 18.5-13, Positioning devices (Bi-national standard, with UL 1565).

.6 CSA C22.2 NO. 65-13, Wire connectors (Tri- national standard, with UL 486A-486B and NMX-J-543-ANCE).

.2 National Electrical Manufacturers Association (NEMA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wire and box connectors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 20.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 or NEMA to consist of:

.1 Connector body and stud clamp for stranded, round copper conductors.

.2 Clamp for stranded, round copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, TECK cable, aluminum sheathed cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.4.

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 wire and box connectors 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 Remove insulation carefully from ends of conductors and cables and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.3 Install fixture type connectors and tighten to CSA C22.2 No.65. Replace insulating cap.

.4 Install bushing stud connectors in accordance with NEMA.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, paddling, and packaging materials in accordance with Section 01 74 20.

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 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

.3 Conductors:

- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.

.4 Insulation:

- .1 Cross-linked polyethylene XLPE.
- .2 Rating: , 600 V.

.5 Inner jacket: polyvinyl chloride material.

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

2.2 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90 - lead sheath over cable assembly and under armour.

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Type: PVC jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.

.5 Connectors: anti short connectors.

2.3 VARIABLE FREQUENCY DRIVE CABLES

.1 Variable Frequency (Speed) Drive Cables: Provide variable frequency drive cables meeting the requirements of CSA C22.2 No. 123 and CSA C22.2 No. 174 from all VFD's to each designated motor load, comprised as follows:

.1 Sectored ground design consisting of 3 bare bonding conductors

.2 1000 volt rated cross linked polyethylene insulated phase conductors

.3 FT4 rated PVC outer jacket

.4 Sized to suit project requirements

Part 3 EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform 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.

3.2 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20.

.2 Cable Colour Coding: to Section 26 05 00.

.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.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34.

.2 In surface and lighting fixture raceways in accordance with Section 26 05 33-01

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable securely supported by hangers.

3.5 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

3.6 INSTALLATION OF VARIABLE FREQUENCY DRIVES

.1 Install and connect to all variable frequency drives (VFD's) supplied with mechanical equipment, and in accordance with VFD cable manufacturers installation requirements.

.2 Provide input power supply to VFD's; provide VFD cable from VFD to designated motor.

END OF SECTION

Part 1 GENERAL

1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.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 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Secure equipment to hollow and solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 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.

.7 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.

.8 For surface mounting of two or more conduits use channels at 3 m on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.13 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 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.2 SUBMITTALS

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

.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 Provide shop drawings: in accordance with Section 01 33 00.

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 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 covers.

2.3 CABINETS

.1 Construction: welded sheet steel as indicated hinged door, handle, latch, lock with 2 keys and catch

.2 Type E Empty: surface return flange mounting.

.3 Type T Terminal: surface return flange containing 19 mm fire retardant treated plywood backboard.

Part 3 EXECUTION

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 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 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00.

.2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.2 SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.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.

.6 Shallow depth boxes where required for flush mounting, coordinate with architectural drawings

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 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.

2.7 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 35mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

.1 'High tension' receptacle fitting made of 2 piece stainless steel or die-cast aluminum with brushed aluminum housing finish for 1 single, 1 duplex and two duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated or as required.

.2 Pedestal type 'low tension' fitting made of 2 piece stainless steel or die cast aluminum with brushed aluminum housing finish to accommodate one and two amphenol jack connectors.

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 International)

.1 CAN/CSA-C22.2 No. 62-93(R2013), Surface Raceway Systems.

1.2 SUBMITTALS

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

.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 Quality assurance submittals: provide following in accordance with Section 01 45 00.

.1 Manufacturer's Instructions: provide manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.4 Indicate types of raceways with terminology similar to that used in this Section.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SURFACE RACEWAY SYSTEM

.1 One piece aluminum, free of sharp edges to CAN/CSA-C22.2 No. 62.

.2 The raceway and all system components must be cUL Listed in full compliance with their standard for surface metal raceways and fittings. All extrusions are to be 6063-T5 aluminum alloy, with nominal wall thickness of 2.03mm throughout.

.3 The surface finish is to be satin, anodized #204 Type clear, Class R1 Mil-Spec with minimum anodized finish of 0.10mm.

.4 Multi-channel to accommodate normal power, emergency power, and communications cabling.

.5 Corners, pull boxes, elbows, tees, two piece assembly to facilitate site wiring.

.6 Switch, receptacle, extension boxes, adapters and fittings required for complete installation.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install raceway to coordinate with casework where shown. Coordinate exact location, mounting height and all other installation details with furniture/casework/millwork supplier/installer and prepare coordination drawings and submit for consultant/owner’s approval prior to commencing installation.

.2 Install raceway systems as indicated and in accordance with manufacturer's instructions.

.3 Install supports, elbows, tees, connectors, fittings, bushings, adaptors as required.

.4 Keep number of elbows, offsets and connections to minimum.

.5 Use wiring with mechanical protection in channel raceways.

.6 Install barriers in raceways for different services where required by code.

.7 Install wiring after installation of raceway system is complete.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA C22.2 NO. 18.1-13, Metallic Outlet Boxes.
- .2 CAN/CSA-C22.2 NO. 18.2-06(R2011), Nonmetallic Outlet Boxes.
- .3 CSA C22.2 No. 18.3-12, Conduit, Tubing, and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B).
- .4 CAN/CSA-C22.2 No. 18.4-04(R2013), Hardware for the Support of Conduit, Tubing, and Cable.
- .5 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit - Steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007).
- .6 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
- .7 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
- .8 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
- .9 CAN/CSA-C22.2 No. 227.3-05(R2010), Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.2 SUBMITTALS

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

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

- .1 Submit cable manufacturing data.

.3 Quality assurance submittals:

- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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.

Part 2 PRODUCTS

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings with expanded ends.

.4 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

.6 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.2 CONDUIT FASTENINGS

.1 One hole steel 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 3 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CSA C22.2 No. 18.3 and CAN/CSA- C22.2 No. 18.4, 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 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

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 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 and in other unfinished areas.

.3 Surface mount conduits except as indicated.

.4 Use rigid galvanized steel threaded conduit except where specified otherwise.

.5 Use epoxy coated conduit in corrosive areas, including acid room.

.6 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.

.7 Use flexible metal conduit for connection to motors in dry areas, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.

.8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.9 Use explosion proof flexible connection for connection to explosion proof motors.

.10 Install conduit sealing fittings in hazardous areas.

.1 Fill with compound.

.11 Minimum conduit size for lighting and power circuits: NPS ¾ 19 mm.

.12 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.13 Mechanically bend steel conduit over 19 mm diameter.

.14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.15 Install fish cord in empty conduits.

.16 Run 2-NPS 1 25 mm spare conduits up to ceiling space and 2-NPS 1 25 mm spare conduits down to ceiling space from each flush panel.

.1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

.17 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.18 Dry conduits out before installing wire.

3.3 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 or surface 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.

3.4 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.

3.5 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.126 1-09, Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA) standards

.1 NEMA VE 1-2002, Metal Cable Tray Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with section 01 33 00.

.2 Identify types of cabletroughs used.

.3 Show actual cabletrough installation details and suspension system.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.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 Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 CABLETROUGH

.1 Cabletroughs and fittings: to NEMA VE 1.

.2 Ventilated type, Class C1 to CAN/CSA C22.2 No.126.

.3 Trays: aluminum, 300 mm wide with depth of 100 mm.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: 600 mm minimum.

.5 Barriers where different voltage systems are in same cabletrough.

2.2 SUPPORTS

.1 Provide supports as required.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install complete cabletrough system.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Secure cables in cabletrough at 6 m centres, with nylon ties.

.4 Identify cables every 30 m with size 2 nameplates in accordance with Section 26 05 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of lighting control equipment including:

- .1 Factory assembled dimming control
- .2 Interfaces and modules
- .3 Low voltage wall stations
- .4 Control interfaces
- .5 Sensors

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

1.3 SUBMITTALS

.1 Provide required information in accordance with Section 01 30 00 – Administrative Requirements.

.2 Action Submittals: Provide the following submittals before starting any Work of this Section:

- .1 Product Data: Submit Product data for lighting control system and all components specified indicating features, characteristics, capacities, limitations and ratings of controllers, interfaces and other components.
- .2 Shop Drawings: Submit Shop Drawings clearly indicating minimum clearances, installation details, fastenings, component identification and as follows:
  - .1 Single line diagram including wiring for power, signal and control systems; differentiate between manufacturer installed and site installed wiring.
  - .2 Indicate zoning of controls and fixtures being controlled.

1.4 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for operations and maintenance procedures, include name of original installer and contact information in accordance with 01 78 00 Closeout Submittals and as follows:

- .1 System Start-up Information
- .2 Installation Guide
- .3 Set-up and Programming Guide

1.5 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications during the course of the Work of this Section:

.1 Manufacturer: Obtain lighting controls system through one source from a single manufacturer or using materials from a secondary source that are acceptable to the manufacturer.

.2 Installer: Install using personnel experienced in installation of lighting control systems of similar design and complexity as required for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.6 SITE CONDITIONS

.1 Ambient Conditions: Do not install equipment until following conditions can be maintained in spaces to receive equipment:

.1 Ambient temperature: 0°C to 40°C

.2 Relative humidity: Maximum 90%, non-condensing.

.3 Protect lighting control system from dust during installation.

1.7 WARRANTY

.1 Warranties specified in this Section are independent from, and run concurrently with, any other warranties for the Contract..

.2 Manufacturer Warranty: Provide manufacturer's written warranty certifying that the specified Products conform to the performance and physical properties listed in this Section, and will remain free of defects in material or manufacture, for a period of two (2) years from date of Substantial Performance of the Work including the following:

.1 Replacement Parts for Manufacturer Lighting System Components: 100% coverage.

.2 Manufacturer Labor Coverage to Troubleshoot and Diagnose a Lighting Issue: 100% coverage.

.3 First–Available Onsite or Remote Response Time

.4 24 Hours per Day, 7 Days per Week Telephone Technical Support, excluding Manufacturer Holidays

.5 Remote Diagnostics for Applicable System

Part 2 Products

2.1 LIGHTING CONTROL MODULE

.1 Description: Surface mounted, low profile, modular control system, passively cooled unaided by fans or other means, with NEMA Type 1, IP-20 protection; rated for 16 amp continuous use per channel, maximum continuous load for a 20 amp overcurrent protection device; programming with integral interface on unit.

.1 Power: 120 volt, single phase

.2 Current Draw: maximum 0.5 amps.

.3 Lightning Strike Protection: ANSI/IEEE 62.41 – can withstand current surges up to 6000 volts and amperage surges up to 3000 amps.

.4 Thermal protection reports to Light Management System if module overheats.

.5 Switching:

.1 Rated life of relay: Minimum 1,000,000 cycles.

.2 Load switched to prevent arcing at mechanical contacts when power is applied to and removed from load circuits.

.3 Fully rated output continuous duty for inductive, capacitive, and resistive loads.

.4 Module to integrate up to 4 individually controlled zones, each with a capacity of up to 16 amps, of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads).

.6 Controls:

.1 Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.

.2 Connects to Lighting Management Panel via RS485 wiring.

.3 LED status indicators confirm communication with occupancy sensors, and daylight sensors.

.4 Single low voltage dimming module; capable of controlling following light sources:

.1 0-10V analog voltage signal:

.1 Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.

.2 Sink current via IEC 60929.

.5 Connection without interface to wired:

.1 Occupancy sensors

.2 Daylight sensors

.6 Contact Closure Input: Directly accept contact closure input from dry contact closure or solid-state output without interface to:

.1 Activate scenes

.2 Enable or disable timeclock

.7 Four (4) occupancy sensor inputs for automated control of lights in four (4) zones).

.8 Four (4) daylight sensor inputs automatically adjust light levels based on the amount of natural light entering through the windows.

.9 One output to BAS system to convey room status

2.2 LOW VOLTAGE INTERFACES

.1 Contact Closure Interface:

.1 Contact closure input device will accept both momentary and maintained contact closures.

.2 Contact closure output device configurable for maintained or pulsed outputs.

.2 Contact Closure Input Interface:

.1 The contact closure input device will accept both momentary and maintained contact closures.

.3 Ethernet Interfaces:

.1 Provide ability to communicate by means of:

.1 TCP/IP over Ethernet

.2 RS232 serial communication

.2 Provide access to:

.1 Scene selections.

.2 Fade zone to a level.

.3 Fine-tuning of preset levels with scene raise/lower.

.4 Lock out scenes and zones.

.5 Fine-tuning of light levels with individual zone raise/lower.

.6 Enable/disable wall station.

.7 Provide status monitoring through button feedback and scene-status updates.

2.3 SENSORS

.1 Wired Ceiling and Wall Mount Occupancy/Vacancy Sensors: NEMA Class 2 devices with all required mounting hardware

.1 Sensing mechanism: Dual technology:

.1 Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

.2 Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.

.2 Connect directly to ballast and modules without the need of a power pack or other interface.

.3 Sensors turn off or reduce lighting automatically after reasonable time delay when a room or area is vacated by last person to occupy space.

.4 Sensor accommodates all conditions of space utilization and all irregular work hours and habits.

.5 Fully adaptive sensors adjust their sensitivity and timing to ensure optimal lighting control for any use of the space

.6 Equip sensors with field adjustable controls for time delay and sensitivity to override any adaptive features.

.7 Power failure memory: Controls incorporate non-volatile memory. Store settings and learned parameters in protected memory to prevent loss during power interruptions; automatically restore settings and learned parameters when power is retored.

.8 Indicate viewing directions on mounting bracket for all Ceiling mount sensors.

.9 Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.

.10 Provide swivel mount base for all wall mount sensors.

.11 Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

2.4 ARCHITECTURAL LOW VOLTAGE WALL STATIONS:

.1 Description: Lighting control wall station with large, rounded, backlit buttons; with LED indicator for input verification; concealed mounting hardware faceplates.

.1 True System Status Functionality: LED indicators to remain illuminated if button press was properly processed. LED indicators turn off if button press was not processed.

.2 Allow for easy reprogramming without replacing unit.

.3 Electronics: Use RS485 wiring for low voltage communication.

.4 Colour: Match NEMA WD1, Section 2

Part 3 Execution

3.1 INSTALLATION

.1 Provide complete installation of system in accordance with Contract Documents and manufacturer’s installation instructions.

.2 Define each dimmer's load type, and set control functions.

.3 Provide sensors at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

.4 Mount exterior daylight sensors with constant view of daylight.

.5 Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.

.6

3.2 CLOSEOUT ACTIVITIES

.1 Start-Up and Adjusting: Perform system start-up in accordance with manufacturer’s recommended procedures and as follows:

.1 Factory-certified field service engineer shall perform site visit to ensure proper system installation and as follows:

.1 Factory-certified Field Service Engineer Qualifications:

.1 Minimum two (2) years experience in training in the electrical/electronic field.

.2 Certified by equipment manufacturer on the system installed.

.2 Make a site visit upon completion of installation of modular dimming control system:

.1 Verify connection of power feeds and load circuits.

.2 Verify connection and location of controls.

.3 Program system data.

.4 Verify proper connection of digital control link.

.5 Verify proper operation of manufacturers interfacing equipment.

.6 Obtain sign-off on system functions.

.2 Demonstration and Training: Provide demonstration and training for operation, maintenance and programming of installed system.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00.

1.2 REFERENCES

.1 CSA International

.1 CSA C9-02(R2007), Dry-Type Transformers.

.2 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.3 REFERENCES

.1 CSA International

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transformers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 kVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Single or Three phase.

.5 Polarity or angular displacement.

.6 Full load efficiency.

.7 Regulation at unity pf.

.8 BIL.

.9 Insulation type.

.10 Sound rating.

.4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

.3 Operation and maintenance instructions to include:

.1 Tap changing.

.2 Recommended environmental conditions.

.3 Recommended periodic inspection and maintenance.

.4 Bushing replacement.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacture of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 20.

1.7 EXTRA MATERIALS

.1 Supply maintenance materials in accordance with Section 01 78 00.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Dry-type transformers: to CSA C9.

2.2 TRANSFORMER CHARACTERISTICS

.1 Type: ANN, ANF, GNC, AFC, GNP, ANC/ANP.

.2 Rating: as indicated.

.3 150 insulation system class, 115 degrees C temperature rise.

.4 Impedance: 4-6 % standard.

.5 Primary winding: as indicated.

.6 Secondary winding: as indicated.

.7 No load losses not to exceed 0.5 % of kVA rating.

.8 Full load losses not to exceed 4 % of kVA rating.

.9 No load and full load losses not to exceed those indicated in CAN/CSA-C802.2.

2.3 ENCLOSURE

.1 Fabricated from sheet steel with drip shield.

.2 Bolted removable panels for access to tap connections, enclosed terminals and other accessories.

.3 Conductor entry:

.1 Knockouts.

.2 Potheads.

.3 Junction boxes.

.4 Bushings.

.5 Clamping rings.

.6 Entry for cable.

.4 Designed for floor, wall mounting and trapeze hung.

.5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65°C rise.

2.4 VOLTAGE TAPS

.1 Standard 5 taps, 1 at nominal voltage, 2 at 2.5% intervals above nominal, 2 at 2.5% intervals below nominal.

2.5 TAP CHANGER

.1 Bolted-link type.

2.6 WINDINGS

.1 Primary and secondary coils:

.1 Copper.

.2 Vacuum cast epoxy.

.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

.3 Sound level: not to exceed 50 dB.

2.7 ACCESSORIES

.1 Winding temperature detector relay and sensing elements with 2 sets of SPDT contacts.

.2 Wiring and terminal box for protective devices.

.3 Grounding terminal: inside of enclosure.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Equipment labels: nameplate size 7, labelled.

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 transformers 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 Locate, install and ground transformer(s) in accordance with manufacturer's instructions.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary terminals to high voltage circuit.

.4 Connect secondary terminals to secondary feeder cable.

.5 Use flexible conduit to make connections to transformer.

.6 Energize transformers and check secondary no-load voltage.

.7 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

.8 Wire one set of contacts on winding temperature detector relay to sound alarm, wire second set of contacts to trip transformer circuit interrupter.

.9 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.

.10 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.11 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Energize transformers and apply incremental loads:

.1 0% for 4 hours.

.2 10% for next 1 hour.

.3 25% for next 2 hours.

.4 50% for next 3 hours.

.5 Full load.

.6 At each load change, check temperatures ambient, enclosure, ventilating air and winding.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.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 transformers installation.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 29 Hangers And Supports For Electrical Systems

.2 26 05 34 Conduits, Conduit Fastenings And Conduit Fittings

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards 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 Ontario, Canada.

.2 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect panelboards from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 120/208V panelboards: bus and breakers rated for 22kA (symmetrical) interrupting capacity or as indicated.

.3 600V panelboards: bus and breakers rated for 18kA (symmetrical) interrupting capacity or as indicated.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Enclosure: sprinkler proof hood

.7 All 120/208V branch circuit panelboards shall be single tub design.

.8 Minimum of 2 flush locks for each panel board.

.9 Two keys for each panelboard and key panelboards alike.

.10 Copper bus with neutral of same ampere rating of mains.

.11 Mains: suitable for bolt-on breakers.

.12 Trim with concealed front bolts and hinges.

.13 Trim and door finish: baked enamel.

.14 Isolated ground bus.

.15 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.

.5 Lock-on devices for fire alarm, exit and night light circuits.

.6 Two and 3 pole breakers shall have common simultaneous trip.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 All panelboard tags indicated on drawings are for design coordination only. All panelboards to be tagged according to local distribution nomenclature. Obtain Departmental Representative approval for all proposed panelboard tags.

.3 Nameplate for each panelboard size 4 engraved.

.4 Nameplate for each circuit in distribution panelboards size 2 engraved.

.5 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Mount panelboards to height specified in Section 26 05 00 or as indicated.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus.

.5 Provide all mounting brackets, busbar drillings and filler pieces for spaces.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 CSA International (CSA)

.1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include time-current characteristic curves for breakers with ampacity of 100 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.3 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted to Departmental Representative for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.4 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

.5 Name and address of building where circuit breakers will be installed:

.1 Project title:

.2 End user's reference number:

.3 List of circuit breakers:

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 circuit breakers indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect circuit breakers from [nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers and ground-fault circuit-interrupters: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.6 Circuit breakers with interchangeable trips as indicated.

.7 Circuit breakers to have minimum 10kA symmetrical rms interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS DESIGN B

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS DESIGN C

.1 Thermal magnetic breakers with current limiters.

.1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.

.2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

.1 Breakers applied following manufacturer's guidelines and accepted best practice.

2.5 SOLID STATE TRIP BREAKERS DESIGN D

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous, tripping for phase, ground fault short circuit protection.

2.6 OPTIONAL FEATURES

.1 Include:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Motor-operated mechanism [c/w time delay unit].

.4 Under-voltage release.

.5 On-off locking device.

.6 Handle mechanism.

2.7 ENCLOSURE

.1 NEMA 2.

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 Install circuit breakers as indicated.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

END OF SECTION

Part 1 GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, size as indicated.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Weatherproof enclosure where installed outdoors

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.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 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 60947-4-1-2009, Low-voltage switchgear and control gear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters.

1.2 ACTION

.1 All starters shall be supplied by Mechanical contractor. Electrical contractor shall install all starters with the exception of the integral starters with the mechanical equipment. Include all required labor and material to facilitate this work. Refer to other Sections for all relevant work.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Take possession, store and handle in accordance with Section 01 61 00.

.2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, paddling, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Starters: to IEC 60947-4-1 with AC4 utilization category by Others.

2.2 MOTOR STARTERS NOT INCLUDING INTEGRAL STARTERS

.1 Shall be supplied by Mechanical contractor to be installed by Electrical contractor.

2.3 CONTROL TRANSFORMER

.1 Shall be supplied and installed by Mechanical contractor utilizing line voltage power supply provided by Electrical contractor. Provide line voltage where required. Coordinate this work on site.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 1 engraved as indicated.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install starters and line voltage control devices in accordance with manufacturer's instructions. All low voltage control devices c/w associated wiring shall be installed by others. Refer to mechanical drawings for locations of starters.

.2 All line voltage wiring on line side and load side of starter and/or VFD by electrical contractor.

.3 Install and wire starters and line voltage controls as indicated.

.4 Ensure correct fuses installed.

.5 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 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.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-2004, American National Standard for Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts.

.2 ANSI C82.4-2002, American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.3 ASTM International Inc.

.1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 Canadian Standards Association (CSA):

.1 CAN/CSA E598-Series-98, Luminaires

.5 Underwriters' Laboratories of Canada (ULC)

.1 UL1598, Standard for Safety of Luminaires

.6 Illuminating Engineering Society of North America (IESNA)

.1 IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products

.2 IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources

.3 IESNA TM-21, Luminaire Classification System for Indoor Luminaires

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.

.3 Photometric data to include: VCP Table where applicable and spacing criterion.

.3 Quality assurance submittals: provide following in accordance with Section 01 45 00.

.1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and processes.

1.3 QUALITY ASSURANCE

.1 Provide mock-ups in accordance with Section 01 45 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.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, paddling and packaging materials in accordance with Section 01 74 20.

.4 Divert unused metal materials from landfill to metal recycling facility.

.5 Disposal and recycling of fluorescent lamps as per local regulations.

.6 Disposal of old PCB filled ballasts.

1.5 COORDINATION

.1 Confirm compatibility and interface with other materials with luminaire and ceiling system, and report discrepancies to the Departmental Representative; defer ordering materials until discrepancies are clarified.

.2 Supply plaster frames, trim rings, and back boxes to other trades, as the work requires.

.3 Coordinate with mechanical subcontractor to avoid conflicts between luminaires, supports and fittings with mechanical equipment; do not suspend fixtures from mechanical equipment, pipes or ducts.

1.6 WARRANTY

.1 Replace completely free of charge:

.1 Fluorescent lamps burning out within 12 months of takeover.

.2 Ballasts that fail or exceed their original noise level rating within 12 months of takeover.

Part 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

.1 Metal Parts: Free of burrs and sharp corners and edges.

.2 Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

.3 Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.2 DIFFUSERS AND GLOBES:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 3.175 mm minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 RECESSED FIXTURES

.1 Supply recessed fixtures complete with trim type required for ceiling system installed.

.2 Before ordering, confirm the ceiling construction details and architectural finish for each area.

.3 Recessed pot-light style fixtures: Provide pre-wired type with junction box forming an integral part of the assembly with satisfactory access complete with necessary plaster rings, supports, and other required accessories for complete installation.

.4 Recessed fluorescent fixtures: Maintain maximum 150 mm depth, including mounting yokes or bridges with distance from back face of fixture or lens to centre of lamp minimum 65 mm; design reflector and lamp positions to provide high efficiency, even brightness and lack of lamp lines.

2.4 SUSPENDED FIXTURES

.1 Coordinate supply of ceiling support for fixtures so that they are suitable for ceiling system installed.

2.5 DRIVERS FOR LED FIXTURES

.1 Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations.

.2 Rated for 50,000 hours of life, unless otherwise noted.

.3 Sound Rating: Class A.

.4 Total Harmonic Distortion Rating: 20 percent or less.

.5 Current Crest Factor: 1.5 or less.

.6 Drivers shall typically operate one luminaire, unless noted otherwise on the light fixture schedule.

.7 Driver shall operate from 50/60 Hz input source of 120 volts, and sustained variations of ± 10% (Voltage & Frequency) with no damage to the driver or solid state circuitry.

.8 Operating Temperature:

.1 Interior: 15C to 30C

.2 Exterior: -40C to 35C

.9 Surge Protection: Automatic, withstand line transients as defined in ANSI C62.41, Category A

.10 Dimming:

.1 Dimming shall be compatible with lighting control system, typically 0 - 10V low voltage dimming

.2 Dimming range shall be 1% - 100% of full light output

.3 Drivers shall be dimmable to 1% minimum flicker free and shall meet IEC 60929 Annex E for max mA draw of 2mA.

.4 Drivers and dimmers to be fully matched and compatible for the quantity of fixtures being dimmed.

.5 Any substitution to the dimming driver control mechanism which requires extra wiring or materials for the lighting control system to operate shall be paid for by the fixture manufacturer.

.11 Drivers shall have a Power Factor greater than 0.98.

2.6 BALLASTS

.1 Programmed Start T8 Ballasts: Ballasts shall operated one or more T8 lamps as indicated in the lighting fixture schedule:

.1 Ballast shall have a minimum Rh/Rc of 4.00 each time the lamps are started.

.2 Ballast shall have a maximum ionization current (Glow Current) of 10 mAmps during the preheating interval.

.3 Ballast shall have a minimum start temperature of -18°C.

.4 Ballasts shall operate from a 50/60 Hz input source of 120 through 347 Volts, and sustained variations of ± 10% (Voltage & Frequency) with no damage to the ballasts; refer to fixture schedule for voltage.

.5 Ballasts shall be high frequency electronic type, and operate lamps at a frequency above 42 kHz to minimize interference with infrared control systems.

.6 Lamp Current Crest Factor (ratio of peak to RMS current) shall be 1.7 or less in accordance with lamp manufacturer recommendation and ANSI C82.11.

.7 Ballasts shall tolerate operation in ambient temperatures up to 40°C without damage.

.8 Ballasts shall comply with FCC Part 18 Non-Consumer Equipment for EMI (power line conducted) and RFI (Radiated).

.9 Ballasts shall provide transient immunity as recommended by ANSI C62.41, Location A2.

.10 Ballasts shall operate lamps with no visible flicker (<3% flicker index).

.11 Ballasts shall tolerate sustained open circuit and short circuit output conditions without damage.

.12 Ballasts shall be Underwriters Laboratory (UL 935) listed, Class P, Type 1 Outdoor, and CSA certified where applicable.

.13 Ballast shall have a Ballast factor greater than 0.85, per ANSI C82.11.

.14 Input current Total Harmonic Distortion shall not exceed 10%.

.15 Ballasts shall have a Power Factor greater than 0.98, for primary application.

.16 Mounting: integral with luminaire.

2.7 LAMPS

.1 Fluorescent lamps to be - T8, 32 Watt, programmed-start, colour temperature as specified, 40,000 hour lamp life, 2800 initial lumens, CRI of Minimum 85; Low Mercury TCLP compliant

.2 LED Light Sources

1.1.1 Photometrics of fixture to be tested according to LM79 requirements

1.1.2 Minimum L70 lamp life within the fixture of 50,000 as measured according to LM80 and TM21

1.1.3 CRI >= 82; R9 >= 35

1.1.4 Colour temperature range from 2700 - 5000 K, as noted on the luminaire schedule; Binning to +/- 200K

1.1.5 Interior LEDs (within luminaires) suitable for an ambient temperature range of 15C to 30C

2.8 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.9 LUMINAIRES

.1 As indicated in luminaire schedule.

Part 3 EXECUTION

3.1 SUPPORTS

.1 Recessed Fixtures:

.1 In areas without suspended ceilings, support fluorescent fixtures directly from the building structure by rod hangers and inserts

.2 Provide plaster frames or plaster trim as required and turn same over to the ceiling section for installation

.3 Support fixtures equal to or larger than 610 mm in width by four hangers per fixture, minimum, independent of ceiling supports or T-bars

.4 Support fixtures smaller than 610 mm in width by two hangers per fixture, minimum, independent of ceiling supports or T-bars

.5 Install recessed fixtures to permit removal from below, to gain access to outlet or pre-wired fixture box.

.6 Connect recessed fixtures to boxes with flexible conduit and approved fixture wire.

.2 Suspended Fixtures:

.1 Install suspended linear fluorescent fixtures with airplane cable and fittings having field adjustable length.

.2 Fixtures shall be installed level unless specifically noted otherwise on Drawings, with less than 10 mm variation over 2440 mm.

.3 Fixtures shall be mounted at the same height above the floor unless specifically noted otherwise on Drawings.

3.2 LUMINAIRE WIRING

.1 Connect recessed luminaires to outlet boxes with flexible conduit using 90°C wire.

3.3 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.4 CLEANING

.1 Specular reflector protection to remain in place through construction

.2 Align luminaries and clean diffusers, baskets and remove reflector protection prior to final acceptance.

.3 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 CSA International

.1 CSA C22.2 No.141-[10], Emergency Lighting Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Construction Waste Management:

.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for [emergency lighting] for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect emergency lighting from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

1.5 WARRANTY

.1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

1.6 COORDINATION

.1 Coordinate installation of receptacles so that they are located in close proximity for connection of battery packs to building power.

Part 2 PRODUCTS

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: 120 V, AC.

.3 Output voltage: 24 V DC.

.4 Operating time: 60 minutes.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment.

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: white

.13 Auxiliary equipment:

- .1 Ammeter.
- .2 Voltmeter.
- .3 Test switch.
- .4 Time delay relay.
- .5 Battery disconnect device.
- .6 AC input and DC output terminal blocks inside cabinet.
- .7 Cord and plug connection for AC.
- .8 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

.1 Conduit: in accordance with Section 26 05 34.

.2 Conductors: in accordance with Section 26 05 21, sized in accordance with manufacturer's recommendations.

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 emergency lighting 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.

3.2 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.3 Connect exit lights to unit equipment.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by emergency lighting installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.141-10, Unit Equipment for Emergency Lighting.

.2 CAN/CSA-C860-11, Performance of Internally Lighted Exit Signs.

.2 National Fire Protection Association (NFPA)

.1 NFPA 101-2012, Life Safety Code.

.3 Underwriters Laboratories of Canada (ULC)

.1 ULC/ORD-924-02, Standard for Emergency Lighting and Power Equipment.

.2 CAN/ULC-S572-10, First Edition Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems.

1.2 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit WHMIS MSDS - Material Safety Data Sheets.

.4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00.

.1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 STANDARD UNITS

.1 Exit lights: to CSA C22.2 No.141 and CSA C860.

.2 Housing: extruded aluminum

.3 Face and back plates: low profile edge-lit acrylic panel. Double face panels standard with capability to modify on site for us in single-face or double-face applications

.4 Lamps: LED, 120V

.5 Operation: designed for 50,000 hours of continuous operation without relamping.

.6 Type: Running man to suit National Building Code

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 INSTALLATION

.1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.

.2 Connect fixtures to exit light circuits.

.3 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect communication raceway systems and wiring 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 and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Telecommunications raceways system consists of outlet boxes, cover plates, terminal distribution cabinets, conduits, pull boxes, sleeves and caps, and fish wires.

.2 Conduit distribution system.

.3 Cable tray distribution system where indicated: refer to Section 26 05 36 Cable Trays For Electrical Systems

2.2 MATERIAL

.1 Conduits: in accordance with Section 26 05 34.

.2 Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 31 and 26 05 32.

.3 Fish wire: polypropylene type.

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 communication raceway systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install raceway system, including overhead distribution system, terminal cabinets, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.

.2 Install fish wire within empty conduits

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 214-08, Communications Cables (Bi-National standard with UL 444).

.2

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

.2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

.3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

1.2 DEFINITIONS

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: distribution, and breakout cables.

1.3 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), and data.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables link work areas to telecommunications rooms located on same floor.

1.4 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 As-built Records and Drawings:

.1 Provide electronic drawings in AutoCAD format depicting all construction.

.2 Provide two (2) bound complete hard-copy sets of as-built records to the Departmental Representative.

.1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FOUR-PAIR 100 BALANCED TWISTED PAIR CABLE

.1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 or FT4 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-B.2.

2.2 MULTI-PAIR 100 BALANCED TWISTED PAIR CABLE

.1 100 ohm, 4 pairs, sheath consists of thermoplastic jacket with underlying metallic shield, Category 3 to: TIA/EIA-568-B.2, flame test classification FT4 or FT6 to: CSA-C22.2 No. 214.

2.3 WORK AREA UTP 2-PAIR.4 MODULAR JACK

.1 Eight-position modular jack ("RJ-45"), type T568B Category 6 to: TIA/EIA-568- [B.2]:

.1 In self-contained surface-mount box, 4 jacks per box.

.2 Mounted in compatible single gang faceplate, flush entry, 4 jack positions per faceplate.

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

.1 IDC Terminal strips, 25 pair, for terminating multi pair 100 balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 6 to: TIA/EIA-568-B.2.

.2 Mount or block for housing 10 IDC terminal strips, mounted on wall, rack or cabinet as indicated.

.1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.

.3 Patch panel, 2 rack units high, 48 ports:

.2 Each port equipped with factory installed "RJ-45" modular type jacks, type T568A Category 6 to: TIA/EIA-568-B.2.

.3 Horizontal cable-management unit for every 48 ports.

2.5 UTP CROSS-CONNECT WIRE

.1 Category 6, 4 pairs to: TIA/EIA-568-B.2.

2.6 UTP PATCH CORDS

.1 2 meters long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-B.2.

2.7 UTP EQUIPMENT CABLE

.1 4 pair "pigtail", 2 meters long, with factory-installed male plug on one end to mate with "RJ-45" jack and other end equipped with factory-installed male plug to mate with "RJ-45" jack: Category 6 to: TIA/EIA-568-B.2.

2.8 UTP WORK AREA CORDS

.1 3 meters long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568-B.2.

Part 3 EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination and cross-connect hardware in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

.2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install horizontal cables as indicated in conduits (and cable tray where indicated) from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.

.2 Terminate horizontal cables in telecommunications room and at individual work-area jacks.

.1 Identify and label as indicated to: TIA/EIA-606-A.

.3 Coil spare cables and store in ceiling space in zone.

.4 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 INSTALLATION OF EQUIPMENT CABLES

.1 Install equipment cables from equipment terminal strips as indicated.

.1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using patch cords as specified.

3.5 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy, and electronic record on CD.

.1 Perform tests for Permanent Link on installed cables, including spares:

.1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.

.1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.2 Provide record of results as hard copy and electronic record on CD to: TIA/TSB-140.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 34 Conduits, Conduit Fastenings And Conduit Fittings

1.2 REFERENCES

.1 Industry Canada - Terminal Attachment Program

.1 CS-03-2010, Compliance Specification.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for sound system and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Riser diagram, block diagram of complete sound system.

.2 Sound system design criteria.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for sound system for incorporation into manual.

.3 Include in manual:

.1 Operation instructions.

.2 Description of system operation.

.3 Description of each subsystem operation.

.4 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.

.5 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit maintenance materials in accordance with Section 01 78 00.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect sound system from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Sound system to incorporate:

.1 Recorded music from digital audio - MP3 WMA AAC player.

.2 Broadcast programs from AM/FM tuner.

.3 Additional features as specified.

.2 Operations:

.1 Music:

.1 Music from tuner or external source.

.2 Speaker selection made via solid-state assembly.

.3 Systems in various configurations to be stand alone.

2.2 MATERIALS

.1 Conduits: in accordance with Section 26 05 34.

.2 Communication conductors: as indicated or as recommended by manufacturer.

2.3 COMPONENTS

.1 Continuous duty cycle.

.2 Solid state

.3 Suitable for tabletop mounting.

.4 Maximum operating temperature: 65 degrees C.

.5 Finish: black

.6 Grounding conductor for system components.

2.4 RECEIVER

.1 Inputs:

.1 3.5mm auxiliary input

.2 Bluetooth input, minimum 5 paired devices

.3 Wi-Fi built-in, pre-loaded with streaming channels

.4 Airplay

.5 AM/FM tuning control

.6 USB storage playback

.2 Outputs:

.1 Speakers, as indicated

.1 115 W/Ch (6 Ohms, 1 kHz, 0.9% THD, 1 Channel Driven, FTC); 65 W/Ch (8 Ohms, 20 Hz–20 kHz, 0.7% 2 Channels Driven, FTC).

.2 3.5mm audio output jack

.3 Controls and indicators, on front panel:

.1 Power on/off switch.

.2 AM/FM/Auxliary/Bluetooth/etc selector switch.

.3 Peak metre.

.4 Bass, treble, volume controls.

.1 1-continuously variable master gain control.

.2 1-bass tone control with centre position flat and 10 dB boost to 10 dB cut either side.

.3 1-treble tone control switch with centre position flat and 10 dB boost 10 dB cut either side.

.5 Tuning metre for AM/FM.

.4 Single-zone

2.5 SPEAKERS

.1 1" liquid cooled titanium pivoting tweeter and 8" cone long throw woofer with butyl rubber surround

.2 Automatic Overload Protection Circuit

.3 Frequency Response: 50 - 20 kHz (+/- 3 dB)

.4 Crossover Frequency: 4 kHz

.5 Sensitivity: 87 dB @ 1 Watt / 1 Meter (2.83 Volts Pink Noise)

.6 Nominal Impedance: 8 Ohms

.7 Hardware in place for easy wall mount installation

.1 Ceiling mounting.

.8 Finish colour: white.

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 public address systems 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

3.2 INSTALLATION

.1 Install equipment in accordance with manufacturer's instructions, and as indicated.

.2 Connect all speakers to receiver

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Conduct room calibration test.

3.4 CLOSEOUT ACTIVITIES

.1 Manufacturer's factory service engineer to instruct:

.1 Maintenance personnel in maintenance of system.

.2 Operating personnel in use of system.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.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.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

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

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by public address and mass notification systems installation.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of a fully addressable networked sound masking system controllable from a single control panel with future options to connect a central computer.

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 05 32 Outlet Boxes, Conduit Boxes and Fittings

.3 Section 26 05 34 – Conduits, Conduit Fastenings And Conduit Fittings

.4 Section 26 05 21 – Wires And Cables (0-1000V)

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

.1 ANSI S1.4-1983 (R2001), American National Standard Specification for Sound Level Meters

.2 ANSI/ASA S1.11-2004 (R2009, American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters

.2 American Society for Testing and Materials (ASTM):

.1 ASTM 1130-08, Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index

.2 ASTM E1374-06(2011), Standard Guide for Open Office Acoustics and Applicable ASTM Standards

.3 ASTM E1433-04, Standard Guide for Selection of Standards on Environmental Acoustics

.4 ASTM E1573-09, Standard Test Method for Evaluating Masking Sound in Open Offices Using A-Weighted and One-Third Octave Band Sound Pressure Levels

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling: Schedule work of this Section so that installation, testing, adjusting, and balancing is performed after above ceiling mechanical and electrical work, suspended acoustic tile ceiling are complete , and as follows:

.1 Schedule installation, testing, tuning, and balancing after normal working hours of users in occupied facilities.

1.5 SUBMITTALS

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

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data identifying components used for the project.

.2 Shop Drawings: Submit shop drawings indicating proposed quantity and location of system components and related wiring and accessories.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Design Submittals: Provide network design schematics indicating general layout and types of equipment proposed for use for Departmental Representative's review and comment before preparing finalized shop drawings listed in this Section.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for operations and maintenance procedures; include name of original installer and contact information in accordance with Section 01 78 00 – Closeout Submittals.

.2 Record Documentation: Submit as constructed information in accordance with Section 01 78 00 – Closeout Submittals including copy of final sound pressure level readings, accurate description of reading locations and test methods and equipment used.

.3 Spare Tools and Software: Submit unique tools and software in accordance with Section 01 78 00 – Closeout Submittals.

1.7 QUALIFICATIONS

.1 Regulatory Requirements: Provide electrical components, devices and accessories, controls and wiring conforming to CSA Standards and CSA labelled in accordance with requirements of Authority Having Jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:

.1 Manufacturer: Use manufacturer that can provide required network design in advance of providing shop drawings and site representation during set-up, testing and commissioning, and that has capacity to provide all network components and devices from a single point of responsibility.

.2 Installer: Use installer that is qualified or approved by component manufacturer having experienced personnel installing and adjusting sound masking systems of similar extent and complexity as required by this Section.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials in manufacturer's original unopened and undamaged packaging with labels intact and legible.

.2 Storage and Handling Requirements: Store in dry locations and handle in accordance with manufacturer's written instructions.

1.9 WARRANTY

.1 Manufacturer Warranty: Submit manufacturer's warranty stating installed are free from defects in parts or assembly for period of five (5) years from date of Substantial Performance for the Project and will be replaced or repaired at no expense during the warranty period without disruption to use of the installed system.

Part 2 PRODUCTS

2.1 SYSTEM DESIGN

.1 Design Requirements: Design network and prepare schematics of network showing quantity and location of network components and related cabling and accessories used to establish bid price before submitting shop drawings; obtain Departmental Representative approval for any changes in quantity or location of sound masking units after shop drawings have been reviewed and accepted.

2.2 PERFORMANCE REQUIREMENTS

.1 Sound Masking Performance: Provide systems using digital signal processing (DSP) technology to generate masking sound and adjustment of masking signals and as follows:

.1 Masking Sound: Random with no noticeable repetitive pattern

.2 Equalizer: Primary network devices capable of equalizing in 1/3 octave increments for masking signal and capable of equalizing zones in groups of 1 to 3 speakers.

.3 Masking Volume: Digitally adjustable in 0.5 dBA increments at each primary network device and grouping of speakers over a range of 35 dBA to 85 dBA measured 1 metre from source

.4 Muting: Muting masking volume control at each primary network device.

.5 Spatial Uniformity: Provide system capable of achieving spatial uniformity of ± 0.5 dBA for masking volume with furnishings in place after adjustment.

.2 Timer Performance: Provide system having timer function allowing masking volume levels to adjust automatically according to programmed schedule and as follows:

.1 Time Scheduling: Calendar based programmable timer function; assigned to individual or group of primary network devices and allowing for the following:

.1 Allow independent timer schedules for each day of the week

.2 Allow variable rates of volume adjustment

.3 Allow exception timer schedules for calendar days requiring different schedule from the normal

.4 Allow programmed system activation date

.2 Daylight Savings: Automatic daylight saving time adjustments

.3 Acclimation Period: Automatic acclimation process that increases masking volume over a period of time according to programmed schedule; allowing for independent acclimatization schedules for each timer zone.

.4 Timer Zones: Allow for up to nine independent timer zones per control panel/programmable timer.

.3 Diagnostic Performance: Provide system capable of providing expected number of primary network devices and communicating correctly with network control panel and that provides failure indication of identifying primary network devices that fail to communicate properly over the network.

.4 Reporting Performance: Provide system network control panel capable of reading and displaying current settings for all primary network devices and generating detailed reports of system settings down to level of individual primary network devices.

.5 Security Performance: Provide locked metal enclosure for network control panel with access to control functions password protected and no physical controls located on system loudspeakers or primary network devices and that allows for settings to be backed up on an electronic storage medium with performance monitoring at each network component.

2.3 COMPONENTS

.1 Provide fully networked decentralized sound masking system comprised of manufacturer's fully addressable components including; but not limited to, the following:

.1 Primary Network Device: Include sound masking generator; equalizer for masking; individual volume control for masking; network communication components; and audio amplifier.

.2 Secondary Network Devices: Provide loudspeaker connections; and signal connections to or from other primary and secondary devices.

.3 Loudspeakers: System matched and enclosed in acoustically dampened enclosure; suspension chain, connections to network devices; and tool-less on-site adjustment of upward or downward speaker orientation.

.4 Network Control Panel: Include required network communication components; control electronics for sound masking and timer functions; connections to audio inputs, network devices, control panels and computer; Ethernet connection and IP addressable.

.5 PC Network Control Software Capable: System must have software that allows for control of system adjustments from a dedicated computer including: network set-up; sound masking volume and equalization adjustment; sound masking timer programs; and programmable keypad set-up. Software not in contract.

.6 Keypads: Fully programmable, network compatible having visual display for function and volume adjustments; infrared remote control receiver and sized to fit within a single gang box.

.7 Accessories: Provide accessories required for a complete and functioning system including; but not limited to: cable assemblies for power, audio and control signals; audio input modules for microphone, telephone and auxiliary audio sources; mounting adaptors; and power supplies.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that plenum heights and power source, and other manufacturer prerequisites are met before beginning of installation of products specified in this Section.

.1 Installation of products specified in this Section will denote acceptance of site conditions.

3.2 INSTALLATION

.1 Install system components in accordance with manufacturer's written instructions and with components placed as indicated on accepted shop drawings.

3.3 CLOSEOUT ACTIVITIES

.1 Start-up and Adjusting: Perform system start-up in accordance with manufacturer's recommended procedures and as follows:

.1 Calibrate measuring microphone and related test equipment prior to start-up and adjusting and as follows:

.2 Balance system with mechanical system and other noise generating equipment shut down, and spaces unoccupied in areas receiving sound masking for duration of start-up operations.

.3 Adjust system until sound spectrum and levels meet required performance requirements; relocate units where required.

.4 Confirm consistency of masking volume and quality.

.2 Demonstration and Training: Provide demonstration and training for operating system as required by Section 01 79 00 – Demonstration and Training and as follows:

.1 Demonstrate operational system by walking the space and indicating nominal operating conditions

.2 Demonstrate functionality of system to facilities personnel; train assigned personnel to maintain system

.3 Commissioning: Provide verification and commissioning services in accordance with Section 01 91 13 – General Commissioning Requirements, and as follows using manufacturer's trained technical representative to measure and report on sound masking system acoustical performance requirements in accordance with ASTM E1573 and as follows:

.1 Performance verification will be performed after Substantial Performance of the Work.

.2 Move sound generating units or replace where commissioning process shows that adjustments are required.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and installation for fire alarm systems.
- .2 Manual alarm stations.
- .3 Automatic alarm initiating devices.
- .4 Audible signal devices.
- .5 Visual alarm signal devices.
- .6 Ancillary devices.
- .7 Verification.

1.2 REFERENCES

.1 National Building Code (NBC)

- .1 National Building Code of Canada 2010

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

- .1 Material Safety Data Sheets (MSDS).

.3 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems.
- .2 CAN/ULC-S525-07, Audible Signal Device for Fire Alarm Systems.
- .3 CAN/ULC-S526-07, Visual Signal Devices for Fire Alarm Systems.
- .4 CAN/ULC-S527-11, Control Units.
- .5 CAN/ULC-S528-14, Manual Pull Stations for Fire Alarm Systems.
- .6 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems.
- .7 CAN/ULC-S530-M91, Heat Actuated Fire Detectors for Fire Alarm Systems.
- .8 CAN/ULC-S531-14, Standard for Smoke Alarms.
- .9 CAN/ULC-S537-13, Standard for Verification of Fire Alarm Systems.
- .10 CAN/ULC-S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

.4 National Fire Protection Agency

- .1 NFPA 72-2007, National Fire Alarm Code.
- .2 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.

.2 Shop Drawings:

.1 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram, including schematics of modules.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

.4 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00.

.2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.

.3 Submit to Authority of Jurisdiction 2 sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.

.4 Submit following:

.1 Manufacturer's Data for:

.1 Control panel and modules.

.2 Manual pull stations.

.3 Heat detectors.

.4 Open-area smoke detectors.

.5 Duct smoke detectors.

.6 Alarm bells.

.7 Wiring.

.8 Conduit.

.9 Outlet boxes.

.10 Fittings for conduit and outlet boxes.

.11 Mark data which describe more than one type of item to indicate which type will be provided.

.12 Submit 1 original for each item and clear, legible, first-generation photocopies for remainder of specified copies.

.2 System wiring diagrams:

.1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.

.3 Design data: Power Calculations:

.1 Submit design calculations for existing system to substantiate that battery capacity exceeds supervisory and alarm power requirements.

.2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.

.3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.

.4 Schedules:

.1 Conductor wire marker schedule.

.5 Test Reports:

.1 Open-area 2-wire smoke detectors.

.2 Preliminary testing:

.1 Final acceptance testing.

.2 Submit for inspections and tests specified under Field Quality Control.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in fire alarm system installations with 5 -years documented experience approved by manufacturer.

.2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

.3 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Include:

.1 Two spare glass rods for manual pull box stations if applicable.

.4 Maintenance Service:

.1 Provide one year's free maintenance on new parts.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

.1 All equipment and devices: ULC listed and labelled, to match existing manufacturer: Edwards

.2 Audible signal devices: to CAN/ULC-S525.

.3 Visual signal devices: to CAN/ULC-S526.

.4 Manual pull stations: to CAN/ULC-S528.

.5 Thermal detectors: to CAN/ULC-S530.

.6 Smoke detectors: to CAN/ULC-S529.

.7 Smoke alarms: to CAN/ULC-S531.

2.2 SYSTEM OPERATION

.1 Provide fire alarm new devices and connect to existing fire alarm system

.2 Utilize separate circuits from control panel for each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.

.3 Determine existing zoning configuration and connect all new devices to the correct zone.

2.3 MANUAL ALARM STATIONS

.1 Provide non-coded single action type with mechanical reset features.

.1 Non-coded single pole normally open contact for single stage.

.2 General alarm key switch for two stage system.

.2 Stations: surface mounted and interior type as indicated.

.1 For surface mounting provide station manufacturer's approved back box.

.2 Back box finish to match station finish.

.3 Equip each station with terminal strip with contacts of proper number and type to perform functions required.

.4 Stations: type not subject to operation by jarring or vibration.

.1 Break-glass-front stations are not permitted;

.5 Station colour: red.

.6 Provide station with visible indication of operation.

.7 Restoration to require use of key.

.1 Keys: identical throughout system for stations and control panel(s).

.8 Mount stations with operating lever not more than 1.2 m above finished floor.

.9 Where weatherproof stations are required, provide stations with cast metal, weatherproof housings with hinged access doors.

.1 Finish housings with red enamel paint and provide permanently bilingual English French signage indicating "FIRE ALARM" with white letters of 19 mm high.

2.4 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise principle.

.2 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type): designed for surface or semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections.

.1 Contacts: self-resetting after response to rate-of-rise actuation

.2 Operation under fixed temperature actuation to result in external indication.

.3 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.

.3 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by photoelectric principle.

.1 Detectors: wire type to match existing

.2 Provide necessary control and power modules required for operation integral with control panel.

.3 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.

.4 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.

.5 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.

.6 Provide remote indicator lamps for each detector that is located above suspended ceilings.

.7 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.

.8 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.

.9 Screen each detector to prevent entrance of insects into detection chamber(s).

.4 Photoelectric Detectors: operate on light scattering principle using LED light source.

.1 Detector: respond to both flaming and smoldering fires.

.5 Locate detectors in accordance with their listing by ULC, except provide at least 2 detectors in rooms of 54 square meters or larger in area.

.6 Mount detectors at underside of ceiling or deck above unless otherwise indicated.

.7 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations are approved for such locations.

.8 Provide detectors with terminal screw type connections.

.9 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

2.5 ALARM INITIATING DEVICE SPACING AND LOCATION

.1 Detector spacing and location: in accordance with manufacturer's recommendations.

.2 Provide at least 2 detectors in rooms of 54 square meters or larger.

.3 Spacing: not to exceed 9m by 9m per detector, and 9 linear m per detector along corridors.

.4 Locate detectors minimum 900m from air discharge or return grille, and not closer than 450 mm to lighting fixtures.

.5 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

2.6 DUCT SMOKE DETECTORS

.1 Provide detectors installed in ducts of photoelectric type and listed by ULC duct installation.

.2 Provide integral control and power modules required for operation with main control panel.

.3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit.

.4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.

.5 Provide a separate, fused power circuit for each smoke detection initiating circuit.

.6 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.

.7 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.

.8 Activation of duct detectors to cause shutdown of associated air handling unit, annunciation at control panel and tripping of master box and sounding of building evacuation alarms.

.9 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.

.10 Provide remote indicator lamp for each detector.

.11 Permanently label remote indicator with tag of associated air handling unit(s).

.12 Provide each detector with remote test switch. Mount switch not more than 1.8 m above finished floor.

.13 Permanently label test switch with tag of associated air handling unit(s).

2.7 AUDIBLE SIGNAL DEVICES

.1 Audible device(s):

.1 Horns: 95 db, flush mounting, 24 V dc.

.2 Do not exceed 80 percent of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.

.3 Provide appliances specifically listed for outdoor use in locations exposed to weather.

.4 Finish appliances in red enamel.

.5 For surface mounting provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

2.8 VISUAL ALARM SIGNAL DEVICES

.1 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuit.

.2 Appliances: minimum of 110 candela measured as approved by ULC, but not less than effective intensity required by National Building Code of Canada for appliance spacing and location.

.3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters 12 mm high.

.4 Provide visible appliances within 300 mm of each audible appliance as indicated.

.5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in same room or corridor.

2.9 CONDUIT

.1 Rigid Steel Conduit:

.1 Zinc-Coated.

.2 Intermediate Metal Conduit (IMC):

.1 Zinc-coated steel only.

.3 Electrical Metallic Tubing (EMT)

.4 Surface Metal Raceway and Fittings:

.1 Two-piece painted steel.

.2 Totally enclosed snap-cover type.

2.10 WIRING

.1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.

.2 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor

.3 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.

.4 Wire for connection to base telegraphic alarm loop: No. 12 AWG minimum solid copper conductor.

.5 Insulation 75 °C minimum with nylon jacket.

.6 For underground or wet allocations cable from control panel to master boxand to telegraphic loop: type UF.

.7 Colour code wiring.

2.11 AS-BUILT RISER DIAGRAM

.1 Fire alarm system riser diagram: on black lamicoid sheet with bevelled edges, white lettering and designations, minimum size 600 x 600 mm.

2.12 ANCILLARY DEVICES

.1 Remote relay unit to initiate fan shutdown.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-04.

.2 Locate and install manual alarm stations and connect to alarm circuit wiring.

.3 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 0.9 m of air outlets. Maintain at least 450 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.4 Connect alarm circuits to main control panel.

.5 Locate and install horns and visual signal devices and connect to signalling circuits.

.6 Connect signalling circuits to main control panel.

.7 Install end-of-line devices at end of alarm and signalling circuit.

.8 Locate and install remote relay units to control fan shut down.

.9 All devices to be installed on the correct zones. Confirm zoning with Departmental Representative.

3.3 FIELD QUALITY CONTROL

.1 Site Tests:

.1 Perform tests in accordance with Section 26 05 00 and CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate alarm.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.4 Class A circuits.

.1 Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.5 Class B circuits.

.1 Test each conductor on circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.4 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11.

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

END OF SECTION

Designated Substances and Hazardous Materials Survey

867 Lakeshore Road,
Burlington, ON

Prepared for:

Public Works Government Services Canada
4900 Yonge Street, 11th Floor
Toronto, Ontario M2N 6A6

Attention: Mei Ling Chen
Environmental Specialist

July 10, 2015

Pinchin File: 97138.001

Issued to:	**Public Works Government Services Canada**
Contact:	**Mei Ling Chen** **Environmental Specialist**
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EXECUTIVE SUMMARY

Public Works Government Services Canada (PWGSC, Client) retained Pinchin Ltd. (Pinchin) on behalf of Environment Canada to conduct a designated substances and hazardous materials assessment of specific areas at the Canada Centre for Inland Waters buildings located at 867 Lakeshore Road, Burlington, ON. The assessment was performed on February 5, 2015. A return site visit with additional sampling was completed on March 19, 2015. Further sampling was performed during the site visit performed for the CES additional scope of work on May 13, 2015.

The objective of the assessment was to identify specified designated substances and hazardous materials in preparation for lab renovations and air handling unit upgrades (AHU). The results of this assessment are intended for use with a properly developed scope of work and performance specification.

The assessed area was limited to the areas of the site as shown highlighted on the drawings in Appendix I. The buildings were occupied at the time of the assessment work.

SUMMARY OF FINDINGS

Asbestos: Asbestos-containing materials (ACM) are confirmed to be present as follows:

- Parging cement insulation on pipe fittings
- Magnesia block insulation on limited pipe straights
- Parging cement on insulated ductwork
- Paper on insulated ductwork
- Parging cement on hot water tank
- Transite fume hood and cabinet lining
- Transite fume hood exhaust ductwork
- Vinyl floor tiles
- Red and brown mastic on and in air handling units
- White interior caulking
- Brown putty on fume hoods
- Bakelite countertops
- Built-up roofing

Lead: Lead is confirmed present in select paints/surface coatings and is present in emergency light batteries.

Silica: Crystalline silica is present in concrete, mortar, masonry, ceramics, etc., where present in the assessed area.

Mercury: Mercury vapour is present in fluorescent lamps throughout the assessed area.

Polychlorinated Biphenyls (PCBs): Suspect PCB-containing equipment and light ballasts were not found.

Ozone Depleting Substances (ODS): ODS were not found within the assessed area. ODS may be present within rooftop units which were not accessible at the time of the assessment.

Mould: Mould-impacted materials were not found.

Stored Chemicals: Chemicals are present in minor quantities within the laboratories.

Other Hazardous Materials: Other hazardous materials including urea formaldehyde foam insulation, fuel or waste oil, hazardous duct residue (perchloric or picric acid), and radioactive materials were not observed during the assessment.

SUMMARY OF RECOMMENDATIONS

The following is a summary of significant recommendations; refer to the body of the report for detailed recommendations.

1. Remove asbestos-containing materials which will be affected by renovation work.
2. Remove mercury-containing lamps prior to demolition or if disturbed by renovation work.
3. Follow appropriate safe work procedures when handling or disturbing lead and silica.
4. Regardless of the planned work, remediate the damaged asbestos-containing parging cement on pipe fittings and insulated ductwork and the flaking lead-containing paint, as outlined in Section 4.2.

Please refer to Section 4.0 of this report for detailed recommendations regarding administrative, renovation or demolition activities.

This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION AND SCOPE

Public Works Government Services Canada (Client) retained Pinchin Ltd. (Pinchin) on behalf of Environment Canada to conduct a designated substances and hazardous materials survey of Canada Centre for Inland Waters, located at 867 Lakeshore Road, Burlington, ON.

The assessment was performed by Leslie Cantar, B. Eng. Mgt, EIT, Project Technologist and David Niemand, Project Technologist on February 5, 2015. A return site visit by Chris Mego, Project Technologist, with additional sampling was completed on March 19, 2015. The third site visit was performed by Leslie Cantar and Damian Palus on May 13, 2015. The surveyors were accompanied as needed by Dave Dautovich and Janna Cuk of Environment Canada during the assessments. The building was occupied at the time of the assessment work.

The objective of the assessment was to identify specified designated substances and hazardous materials in preparation for lab renovations and air handling unit upgrades (AHU). This assessment is intended to be used for pre-construction purposes only, and may not provide sufficient detail for long term management of designated substances and hazardous materials as required by Health and Safety regulations.

1.1 Scope of Assessment

The assessment was performed to establish the location and type of specified hazardous building materials incorporated in the structures and their finishes. The assessed area was limited to the parts of the building within the areas to be renovated as described in the Statement of Work (SOW). The extent of the assessed area was defined by the Client and Dialog Design.

For the purpose of the assessment and this report, hazardous building materials are defined as follows:

- Asbestos
- Lead
- Silica
- Mercury

The assessment also included:

- Polychlorinated biphenyls (PCBs)
- Ozone depleting substances
- Mould
- Urea formaldehyde foam insulation
- Fuel, oil and/or waste oil storage

- Chemical storage
- Hazardous film or residue within the ducts (Perchloric and Picric Acids)
- Radioactive materials (where signage is present)

The following Ontario Designated Substances are not typically found in building materials in a composition/state that is hazardous and were not included in this assessment:

- Arsenic
- Acrylonitrile
- Benzene
- Coke oven emissions
- Ethylene oxide
- Isocyanates
- Vinyl chloride monomer

2.0 BACKGROUND INFORMATION

Building Description Item	Details
Building Use	Institutional (research and laboratories).
Number of Floors/Levels	8 storeys plus one below grade
Total Area of Building (Square Feet)	300,000
Year of Construction/Significant Additions/Renovations (area assessed)	Approximately 1960 with various additions/renovations up until 2014
Structure	Structural steel, concrete, wood, and concrete block
Exterior Cladding	Pre-cast concrete, metal siding, vinyl siding, brick, and concrete block
HVAC	Boilers and hot water or steam heating to radiators
Roof	Built-up roofing
Flooring	Vinyl tile, vinyl sheet flooring, terrazzo, carpet, concrete, wood and ceramic tile
Interior Walls	Drywall, concrete block, plaster, and brick

Building Description Item	Details
Ceilings	Drywall, acoustic ceiling tiles, and plaster

2.1 Existing Reports

Pinchin previously prepared the following existing reports which were used as reference:

- "Asbestos Assessment of CCIW 867 Lakeshore Road, Burlington", Dated July 12, 2013, Pinchin File: 79576
- "Hazardous Building Materials Assessment of CCIW 867 Lakeshore Road, Burlington", Dated December 19, 2014, Pinchin File: 87784.

Pinchin was provided and relied on the following existing reports:

- "CCIW Lab Report", Dated October 2011, By District 2 Property Management.
- "Level 2 (Life Cycle) Building Condition Report for Environment Canada Centre for Inland Waters (CCIW) in Burlington, Ontario", Dated September 2009, By PWGSC - RPB - PTP - Maintenance Management Services.
- "CCIW Air Handling Unit Assessment Report", Dated December 2, 2014, By Filer Engineering Ltd.

2.2 Inaccessible Locations

Roof areas which were inaccessible during the original site visit were accessed during the May 13, 2015 site visit. Findings for these areas have been included in this report.

3.0 FINDINGS

3.1 Asbestos

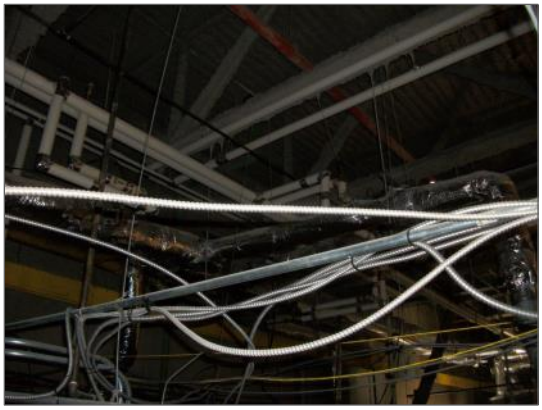
3.1.1 Suspect Building Materials Not Found

The following types of building materials may historically contain asbestos but were not observed in the building and are not discussed in the report findings:

- Texture finishes (acoustic/decorative)
- Plaster
- Vinyl sheet flooring
- Firestopping

3.1.2 Spray-Applied Fireproofing and Thermal Insulation

Non-asbestos fibrous sprayed fireproofing (previously sampled) and overspray is present on the structure within the Hydraulics Labs H158 and H160 and is present on the structure within the Second Floor of the Wastewater Technology Centre (WTC).



Non-asbestos fibrous sprayed fireproofing on structure over Hydraulics Lab H158

3.1.3 Thermal Systems Insulation (TSI)

3.1.3.1 Pipe Insulation

Parging cement, containing chrysotile asbestos, is present on pipe fittings (elbows, valves, tees, hangers, etc.) on the majority of insulated systems throughout the assessed areas. Parging cement is a friable insulation, jacketed with canvas and ranges from damaged to good condition.

A white preformed block insulation (commonly referred to by the trade names Magnesia Block or Mag Block), containing chrysotile and amosite asbestos, is present in limited locations on straight sections of steam and condensate system pipes. Magnesia block is a friable insulation, jacketed with canvas and ranges from damaged to good condition.

Non-asbestos sweatwrap insulation (brown layered paper), is present on straight sections of cold water system pipes, sanitary drains and rain water leaders.

Non-asbestos fibreglass insulation is present on the majority of straight sections of pipe throughout the site. Non-asbestos tar is present on fibreglass pipes throughout the Administration and Laboratory (A&L) building. There was no asbestos parging cement noted on the seams of the insulation at the locations inspected.

Pipes insulated with friable asbestos insulations may be present in inaccessible spaces such as above solid ceilings, in chases, in column enclosures and within shafts.

Non-asbestos insulations (e.g. fibreglass, armaflex) are present on remaining pipes throughout the assessed areas.

Asbestos-containing pipe insulations are present in the following location, quantity, and condition:

Pipe System, Type	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Parging cement on pipe fittings	Research and Development (R&D) Mechanical Penthouse at System 1	Previously Sampled	Chrysotile	125 EA	10 EA
Parging cement on pipe fittings	R&D Mechanical Penthouse at Systems 3 and 5	Previously Sampled	Chrysotile	20 EA	5 EA
Parging cement on pipe fittings	R&D Mechanical Penthouse between System 1 and System 5	Previously Sampled	Chrysotile	30 EA	0 EA
Magnesia block on condensate pipe straight	Service Core adjacent to Lab L527	Previously Sampled	Chrysotile and Amosite	30 LF	0 LF
Parging cement on condensate/steam line pipe fittings	Service Core adjacent to Lab L527	Previously Sampled	Chrysotile and Amosite	4 EA	0 EA
Parging cement on rainwater leader pipe fitting	Above Freezers adjacent to Electrical/Mechanical Room H159	Previously Sampled	Chrysotile	1 EA	0 EA
Parging cement on pipe fittings	Equipment Room H245 at abandoned air handling unit	Previously Sampled	Chrysotile	35 EA	0 EA
Parging cement on pipe fittings	Equipment Room H245 at operating air handling unit and abandoned unit	Previously Sampled	Chrysotile	20 EA	0 EA
Parging cement debris from previously removed pipe insulation	Equipment Room H245 at abandoned air handling unit	Previously Sampled	Chrysotile	10 SF	10 SF

Pipe System, Type	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Parging cement on pipe fittings	Hydraulics Mezzanine Corridor/Catwalk at AHU 43	Previously Sampled	Chrysotile	15 EA	4 EA
Parging cement on pipe fittings	Above Offices at AHU 43	Previously Sampled	Chrysotile	6 EA	0 EA
Parging cement on pipe fittings	Tunnel to WTC	Previously Sampled	Chrysotile	200 EA	3 EA
Parging cement on pipe fittings	Second Floor in WTC Open Lab Area	Previously Sampled	Chrysotile	65 EA	0 EA
Parging cement on pipe fittings	Electrical Room in WTC Penthouse	Previously Sampled	Chrysotile	10 EA	0 EA
Parging cement on pipe fittings	WTC Mechanical Penthouse	Previously Sampled	Chrysotile	105 EA	12 EA
Parging cement on pipe fittings	WTC Basement at Tunnel Entrance	Previously Sampled	Chrysotile	30 EA	0 EA

Damaged parging cement fitting behind System 1 HVAC unit, R&D Mechanical Penthouse

Damaged parging cement fitting at System 5 HVAC unit, R&D Mechanical Penthouse

Refer to additional photographs in Appendix IV.

3.1.3.2 Duct Insulation

Parging cement, containing chrysotile asbestos (previously sampled), is present over fibreglass insulation at edges, seams and pins on the lower sections of the outer square ductwork serving the System 1 HVAC

unit in the R&D Mechanical Penthouse (approximately 300 SF). Parging cement is a friable insulation, jacketed with canvas and is in good condition with the exception of a one square foot patch present on the back of the system.

Paper, containing chrysotile asbestos, is present on the round hot ductwork serving System 1 in the R&D Mechanical Penthouse (sample 0003A). Paper is a friable material, jacketed with canvas, and in good condition (approximately 600 SF).

Parging cement, containing chrysotile asbestos (previously sampled), is present over fibreglass insulation at edges, seams and pins on the lower sections of the square ductwork serving AHU 43 in the Hydraulics Mezzanine (approximately 20 SF). Parging cement is a friable insulation, jacketed with canvas and is in good condition.

Parging cement, containing chrysotile asbestos, is present on insulated ductwork near the pipe chase within the WTC Mechanical Penthouse (sample 0016A). Parging cement is a friable insulation, jacketed with canvas and is in good condition (approximately 50 square feet) with the exception of approximately five square feet of damage.

Remaining ducts are either uninsulated or insulated with non-asbestos fibreglass and jacketed with either canvas or foil.

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Parging cement on insulated square ductwork	Research and Development (R&D) Mechanical Penthouse at System 1	Previously Sampled	Chrysotile	300 SF	1 SF
Paper on insulated round ductwork	Research and Development (R&D) Mechanical Penthouse at System 1	0003A	Chrysotile	600 SF	0 SF
Parging cement on insulated square ductwork	Hydraulics Mezzanine Corridor/Catwalk at AHU 43	Previously Sampled	Chrysotile	20 SF	0 SF
Parging cement on insulated ductwork	WTC Mechanical Penthouse (near pipe chase)	0016A	Chrysotile	50 SF	5 SF

Damaged asbestos-containing parging cement on square ductwork serving System 1, R&D Mechanical Penthouse

Asbestos-containing paper on two centre round hot ducts serving System 1, R&D Mechanical Penthouse

Refer to additional photographs in Appendix IV.

3.1.3.3 Mechanical Equipment Insulation

Parging cement, containing chrysotile asbestos, is present on joints of the yellow condensate tank in the WTC Mechanical Penthouse. Parging cement is a friable insulation, jacketed with canvas and is in good condition (approximately 50 SF).

Remaining mechanical equipment is insulated with non-asbestos fibreglass or is not insulated.

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Parging cement on condensate tank	WTC Mechanical Penthouse	Previously Sampled	Chrysotile	50 SF	0 SF

3.1.4 Vermiculite

Loose fill vermiculite is not present in the assessed areas. Masonry block walls were inspected at existing openings.

3.1.5 Acoustic Ceiling Tiles

All ceiling tiles present within the assessed areas were determined to be non-asbestos based on the date of manufacture based on the date stamp applied to the top of the tiles. The tiles were manufactured after asbestos stopped being used in acoustic ceiling tiles.

3.1.6 Plaster

Rough and smooth plaster present throughout the assessed areas is non-asbestos.

3.1.7 Drywall Joint Compound

The majority of drywall finishes present in the assessed areas consisted of panels without joint compound. Drywall joint compound present throughout the assessed areas is non-asbestos (previously sampled).

3.1.8 Asbestos Cement Products (Transite)

Transite board is present in fume hoods and chemical storage cabinets in Laboratory L530 (approximately 130 SF).

Transite pipes are present as exhausts from fume hoods in Laboratory L530 and in the adjacent Service Core (approximately 100 LF).

Transite is presumed to contain asbestos based on visual observation. Transite is non-friable and in good condition.

Fume hoods and cabinets in Lab H158 are lined with plastic boards. Fume hood exhausts are metal.

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Transite board in fume hoods and chemical storage cabinets	Laboratory L530	Visually Assessed	Chrysotile (assumed)	130 SF	0 SF
Transite exhaust pipes	Laboratory L530 and adjacent section of Service Core	Visually Assessed	Chrysotile (assumed)	100 LF	0 SF

Transite board lining fume hood, Laboratory L530

Transite pipe exhaust from fume hood, Laboratory L530

Refer to additional photographs in Appendix IV.

3.1.9 Vinyl Floor Tile and Mastic

Vinyl floor tiles are present as follows:

Size, Pattern, Colour and Photo Number	Locations (Quantity)	Sample Number	Asbestos Type (tile)	Asbestos Type (mastic)
12” x 12” vinyl floor tile, grey with black streaks	Fifth Floor Corridor adjacent to Labs L527 and L530 (1,000 SF), Catwalk and Corridor at AHU 43 in Hydraulic Lab (1,200 SF)	Previously Sampled	Chrysotile	None Detected
12” x 12” vinyl floor tile, white with grey specks	Fifth Floor Labs L527 and L530, Corridor at AHU 43 in Hydraulic Lab (2,500 SF)	0017 (TEM sample result)	Chrysotile	None Detected
12” x 12” vinyl floor tile, white with grey streaks	Lab H158, Corridor at AHU 43 in Hydraulic Lab,	Previously Sampled and 0018	None Detected	None Detected

The vinyl floor tiles are non-friable and are in good condition.

Asbestos-containing vinyl floor tiles, Lab H530

3.1.10 Sealants, Mastic, Caulking, and Putty

Red mastic, applied to interior and exterior joints of AHUs 1, 3, and 5, was sampled in the R&D Mechanical Penthouse (sample 0001A). Mastic contains chrysotile asbestos, is non-friable, and in good condition (approximately 750 linear feet).

Non-asbestos black foam sealant adhered with yellow adhesive is present at access doors of AHU 1 in the R&D Mechanical Penthouse (samples 0002A-C).

Non-asbestos black tar is present at structural penetrations through the floor at AHU 1 within the R&D Mechanical Penthouse (samples 0004A-C).

White caulking, containing chrysotile asbestos, is present at door frames and joints of concrete block walls within Lab L530 and Lab L527 (sample 0005A). Caulking is a non-friable material present in good condition (approximately 50 linear feet).

Brown putty, containing chrysotile asbestos, is present at the perimeter of glass windows in the fume hoods within Lab L530 (sample 0007A). Putty is a non-friable material present in good condition (approximately 60 linear feet).

Non-asbestos red mastic is present on ducts throughout the A&L building (previously sampled).

Brown mastic, containing chrysotile asbestos, is present at joints of the abandoned air handling unit in Equipment Room H245 (sample 0010A). Mastic is non-friable and in good condition (approximately 30 linear feet).

Non-asbestos grey caulking is present at door frames in Equipment Room H245 (samples 0012A-C).

Non-asbestos black tar is present over fibreglass insulation inside the abandoned AHU in Equipment Room H245 (samples 0013A-C).

Non-asbestos yellow mastic is present on blue ductwork serving AHU 43 in the Hydraulic Lab Mezzanine (samples 0014A-C).

Non-asbestos brown caulking is present at door frames in the WTC Mechanical Penthouse (samples 0015A-C).

Non-asbestos brown caulking is present at seams and joints of the exhaust ductwork serving AHU 5 in the R&D Mechanical Penthouse (samples 0024A-C).

Non-asbestos black tar is present at gas pipe penetrations through the roof adjacent to AHU 44 on the Roof of the Hydraulics Building (samples 0025A-C).

Non-asbestos black mastic is present at corners and seams of ductwork serving AHU 44 on the Roof of the Hydraulics Building (samples 0026A-C).

Non-asbestos grey caulking is present at electrical wiring penetrations through the roof adjacent to the exhausts on the Roof of the Hydraulics Building (samples 0027A-C).

Non-asbestos grey caulking is present on exterior seams and joints of AHU 44 on the Roof of the Hydraulics Building (samples 0028A-C).

Sealants, mastic, caulking, and putty are non-friable and in good condition.

Remaining sealants, caulking, and putty present in the assessed areas were determined to be non-asbestos based on the nature of the material (silicone or rubber).

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Red mastic on joints of AHUs 1, 3, & 5	R&D Mechanical Penthouse	0001A	Chrysotile	750 LF	0 LF
White caulking at door frames and joints of concrete block	Lab L530	0005A	Chrysotile	30 LF	0 LF
White caulking at door frames and joints of concrete block	Lab L527	0005A	Chrysotile	20 LF	0 LF
Brown putty at windows in fume hoods	Lab L530	0007A	Chrysotile	60 LF	0 LF
Brown mastic at joints of abandoned AHU	Equipment Room H235	0010A	Chrysotile	30 LF	0 LF

Asbestos-containing red mastic at joints of AHU 1, R&D Mechanical Penthouse

Painted asbestos-containing brown mastic on abandoned AHU, Equipment Room H245

Refer to additional photographs in Appendix IV.

3.1.11 Other Building Materials

Bakelite is present as a countertop finish within Laboratories L527 and L530. Bakelite is a non-friable material that is presumed to contain asbestos based on visual identification. All Bakelite is in good condition (approximately 250 SF).

Built-up roofing, presumed to contain asbestos based on historical knowledge, is present over the building. Asbestos is presumed to be present in the tar layer of roofing, which is a non-friable material and in good condition. Built-up roofing was not sampled during the assessment due to the intrusive nature of the sampling, and is best sampled prior to renovations where the exact locations of required roofing penetrations are known.

Non-asbestos white undercoating is present on sinks within Lab L530 and Lab L527 (samples 0006A-C).

Non-asbestos brown baseboard mastic is present within Lab L530 and Lab L527 (samples 0008A-C).

Non-asbestos yellow baseboard mastic is present within Lab H158 (samples 0009A-C).

Non-asbestos vibration dampers are present at connections on the abandoned AHU in Equipment Room H245 (samples 0011A-C). Remaining vibration dampers within the assessed area were determined to be non-asbestos based on the rubberized nature of the materials.

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Bakelite	Laboratory L530	Visually Assessed	Chrysotile (assumed)	200 SF	0 SF
Bakelite	Laboratory L527	Visually Assessed	Chrysotile (assumed)	50 SF	0 SF
Built-up roofing	All Buildings	Not sampled	Chrysotile (assumed)	100 %	0 % (assumed)

Non-asbestos white sink undercoating, Lab L530

Non-asbestos vibration damper on abandoned AHU, Equipment Room H245

Refer to additional photographs in Appendix IV.

3.1.12 Presumed Asbestos Materials

A number of materials which might contain asbestos were not sampled during our assessment due to limitations in scope and methodology. Where present, these materials must be presumed to be an asbestos material and are best sampled during project planning and preparation of contract documents for their removal. Materials presumed to contain asbestos include:

- roofing, felts and tar
- concrete floor levelling compound
- electrical components or wiring within control centers, breakers, motors or lights, insulation on wiring
- mechanical packing, ropes and gaskets
- fire resistant doors or metal clad finishes

3.2 Lead

3.2.1 Paints and Surface Coatings

A total of 14 paint samples were collected from interior and exterior painted finishes. The following table summarizes the analytical results for paints sampled and their locations.

Sample Number	Colour, Substrate Description	Locations	Lead (%)
L001	Blue paint on metal AHU 1	R&D Mechanical Penthouse	4.2
L002	Red paint on structural steel within AHU 1	R&D Mechanical Penthouse	10
L003	Green paint on steel at concrete pad within AHU 1	R&D Mechanical Penthouse	5.5
L004	Grey paint on metal fan housing within AHU 1	R&D Mechanical Penthouse	0.11
L005	Silver paint on steel structure within AHU 1	R&D Mechanical Penthouse	0.094
L006	Green paint on metal AHUs and insulation pipes	R&D Mechanical Penthouse (AHUs 1, 3 and 5), Equipment Room H245, Hydraulics Mezzanine	11
L007	Yellow paint on pipes	R&D Mechanical Penthouse, Equipment Room H245	1.2

Sample Number	Colour, Substrate Description	Locations	Lead (%)
L008	Orange paint on metal fume hood	Lab L530	8.5
L009	White paint on concrete block wall	Lab L530	0.050
L011	Orange paint on metal door	WTC Mechanical Penthouse	2.7
L012	Black paint on steel structure	WTC Mechanical Penthouse	0.47
L013	Off-white paint on steel structure	WTC Mechanical Penthouse	0.25
L014	Grey paint on concrete floor	WTC Mechanical Penthouse	0.056
L017	White paint on steel beam,	Hydraulics Mezzanine Level at AHU 43	0.27
L018	Grey paint on metal exterior of AHU 44	Roof of Hydraulics Building	0.010
L021	Black paint on exterior metal cladding	Roof of WTC at Penthouse	0.027

Subject paint was flaking/peeling in the following areas on the following items:

- Green paint on front of AHU 1 in R&D Mechanical Penthouse, 10 square feet (SF) flaking;
- Green paint on back of AHU 1 in R&D Mechanical Penthouse, 15 SF flaking and 10 SF debris; and
- Green paint on AHU 3 in R&D Mechanical Penthouse, 50 SF flaking.

Flaking green paint on the back of AHU 1 in R&D Mechanical

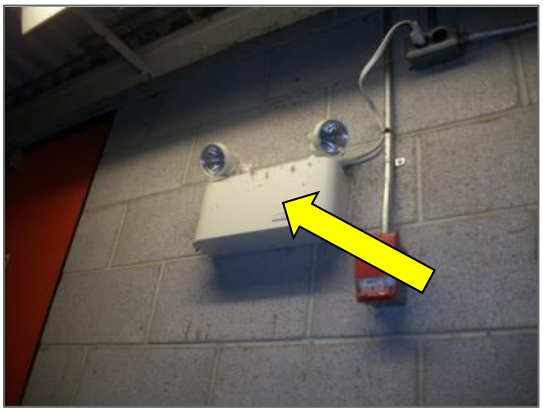
Flaking green paint on the AHU 3 in R&D Mechanical

Penthouse	Penthouse

Appendix II-B presents the lead testing or bulk sample analytical results.

3.2.2 Lead Products and Applications

Lead-containing batteries are present in emergency lighting present in the WTC Penthouse.



Back-up emergency lighting contains lead acid batteries, WTC Penthouse Electrical Room

3.2.3 Presumed Lead Materials

Lead may be present in a number of materials which were not assessed and/or sampled. The following materials, where found, should be considered to contain lead.

- electrical components, including wiring connectors, fibre optic cable sheathing, grounding conductors, and solder

3.3 Silica

Crystalline silica is a presumed component of the following building materials where present in the building:

- poured or pre-cast concrete
- masonry and mortar
- plaster

3.4 Mercury

3.4.1 Lamps

Mercury vapour is present in fluorescent lamps where present in the assessed area.

3.4.2 Mercury-Containing Devices

Mercury-containing devices were not found during the survey.

3.5 Polychlorinated Biphenyls

3.5.1 Caulking

Suspect exterior caulking which would be affected by the renovations was not present within the assessed area.

3.5.2 Lighting Ballasts

Based on information from the Client and confirmed by visual observations (evidence of T-8 fixtures) the site has been comprehensively re-lamped and will not contain PCB ballasts.

3.5.3 Transformers

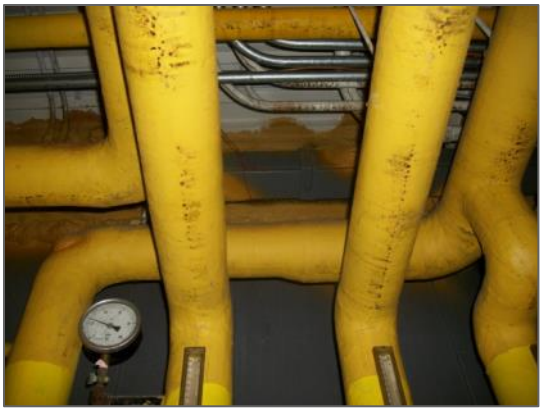
All transformers in the site are dry type transformers and do not contain PCB-containing dielectric fluids.

3.6 Ozone Depleting Substances

Ozone depleting substance R22 is listed as the factory charged refrigerant in AHU 44 on the roof of the Hydraulics Building. Maintenance records were not accessible to verify the type of refrigerants used.

3.7 Mould

Visible mould growth was not found in the assessed area. Staining was observed on insulated pipes in the WTC Mechanical Penthouse. A tape lift sample was collected (sample B1063875) and mould growth was not detected.



No mould growth detected with water-staining on pipes, Wastewater Technology Centre Mechanical Penthouse

3.8 Hazardous Chemicals

The following chemicals were listed as having been used in the labs included in the assessed area, as per the CCIW Lab Report provided by Environment Canada:

Laboratory	Predominant Chemicals
Lab L527 – Organic Sediments Lab	Standard mixtures of greenhouse gases (CO2, N2O, CH4, CO) in nitrogen, phosphoric acid, pure copper and tin in scrubbers, platinum in catalysts
Lab L530 – Geochemistry Lab	Sulfuric acid, methanol, ethanol
Lab H158 – Water Sample Processing Lab	Hydrochloric acid, methanol

Other chemicals may be present in minor quantities and are not expected to be present as residue in ductwork.

3.9 Other Hazardous Materials

Other hazardous materials including urea formaldehyde foam insulation, fuel or waste oil, hazardous duct residue (perchloric or picric acid), and radioactive materials were not observed during the assessment.

4.0 RECOMMENDATIONS

4.1 General

1. Prepare plans and specifications for hazardous material removal which will or may be affected by the planned work or is otherwise scheduled for removal. The specifications should include and address the scope of work, safe work practices, personal protective equipment, respiratory protection, and disposal of waste materials.
2. Investigate any items excluded from the scope of work of this report. Ideally this investigation will be performed immediately prior to commencing renovations. Specifically the following materials/areas need to be investigated:
    - Presumed asbestos-containing built-up roofing in areas where penetrations or removal will be required.
3. Provide this report and the detailed plans and specifications to the contractor prior to bidding or commencing work.
4. Retain a qualified consultant to specify, inspect and verify the successful removal of designated substances and hazardous materials.

5. Update the asbestos inventory upon completion of the abatement and removal of asbestos-containing materials.

4.2 Remedial Work

We recommend the following remedial work be performed to comply with existing regulations, regardless of proposed construction work due to the condition and location of the material:

Material and Quantity	Location	Recommended Procedure
Parging cement on pipe fittings, 10 fittings	R&D Mechanical Penthouse at System 1	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement on pipe fittings, 5 fittings	R&D Mechanical Penthouse at Systems 3 and 5	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement debris from previously removed pipe insulation, 10 SF	Equipment Room H245 at abandoned air handling unit	Clean-up following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement on pipe fittings, 4 fittings	Hydraulics Mezzanine Corridor/Catwalk at AHU 43	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement on pipe fittings, 3 fittings	Tunnel to WTC	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement on pipe fittings, 12 fittings	WTC Mechanical Penthouse	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement on insulated duct, 1 SF	R&D Mechanical Penthouse at System 1	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Parging cement on insulated duct, 5 SF	WTC Mechanical Penthouse	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Green paint on front of System 1 HVAC unit, 10 SF flaking	R&D Mechanical Penthouse at System 1	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document
Green paint on front of System 1 HVAC unit, 15	R&D Mechanical Penthouse at	Removal and clean-up following Type 2a lead procedures as per Lead on

Material and Quantity	Location	Recommended Procedure
SF flaking and 10 SF debris	System 1	Construction Projects, Ministry of Labour Guidance Document
Green paint on front of System 3 HVAC unit, 50 SF flaking	R&D Mechanical Penthouse at System 3	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document

The cost estimate to complete all remedial work as outlined in the above table is $5,000.00, plus applicable taxes.

4.3 Building Renovation Work

The following recommendations are made regarding demolition or renovation involving the designated substances and hazardous materials identified; refer to sections below for additional information for Designated Substance and Hazardous Material abatement.

Designated Substance/ Hazardous Material	Material(s)	Recommended Regulation/ Guideline to be Followed
Asbestos	• Pipe insulation • Duct insulation • Mechanical insulation • Transite • Vinyl floor tiles • Mastics • Caulking • Bakelite • Putty • Built-up roofing	Ontario Regulation 278/05
Lead	• Paint • Emergency light batteries	Ministry of Labour Guideline – Lead on Construction Projects, 2004
Silica	• Concrete, mortar, masonry and ceramics	Ministry of Labour Guideline – Silica on Construction Projects, 2004
Mercury	• Fluorescent lamps	R.R.O. 1990, Regulation 844, Amended to O.Reg. 110/04, Designated Substance — Mercury

Designated Substance/ Hazardous Material	Material(s)	Recommended Regulation/ Guideline to be Followed
Ozone Depleting Substances	• Within rooftop HVAC units	Federal Halocarbon Regulations, 2003
Stored Chemicals	• Greenhouse gases (CO2, N2O, CH4, CO) in nitrogen, phosphoric acid, pure copper and tin in scrubbers, platinum in catalysts • Sulfuric acid, methanol, ethanol • Hydrochloric acid, methanol	Follow appropriate handling and removal procedures as per the Material Safety Data Sheets

4.3.1 Asbestos

Remove all asbestos-containing materials (ACM) prior to renovation, alteration, maintenance or demolition work or if ACM may be disturbed by the work.

If the identified ACM will not be removed prior to commencement of the work, disturbance of ACM must follow the appropriate asbestos precautions for the classification of work being performed.

Asbestos-containing materials must be disposed of at a landfill approved to accept asbestos waste.

4.3.1.1 Pipe Insulation

If pipe insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing pipe insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of pipe insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05. Alternately use Glove Bag Procedures as outlined within Ontario Regulation 278/05.

If jacketing over asbestos insulation is to be repaired (e.g. canvas and lagging), use Type 2 procedures as outlined within Ontario Regulation 278/05.

4.3.1.2 Duct Insulation

If parging cement on duct insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of duct insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05.

If jacketing over asbestos parging cement insulation is to be repaired (e.g. canvas and lagging), use Type 2 procedures as outlined within Ontario Regulation 278/05.

If paper on duct insulation is to be removed, remove using Type 2 asbestos procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools

4.3.1.3 Mechanical Insulation

If parging cement on mechanical insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of mechanical insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05.

If jacketing over asbestos parging cement insulation is to be repaired (e.g. canvas and lagging), use Type 2 procedures as outlined within Ontario Regulation 278/05.

4.3.1.4 Asbestos-Cement (Transite) Materials

If asbestos cement (Transite) materials must be removed as a result of planned demolition, renovation, etc. use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.5 Vinyl Floor Tiles

If vinyl floor tiles must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.6 Sealants, Mastic, Caulking, and Putty

If the caulking must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.7 Bakelite

If the Bakelite must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.8 Built-up Roofing

If the built-up roofing must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.2 Lead

Construction disturbance of lead in paint and coatings (or other materials) may result in over-exposure to lead dust or fumes. The need for work procedures, engineering controls and personal protective equipment will need to be assessed on a project-by-project basis and must comply with provincial standards or guidelines. Performing an exposure assessment during work that disturbs lead in paints and coatings may be able to alleviate the use of some of the precautions specified by these standards or guidelines.

These lead operations and precautions are outlined in the Ministry of Labour Guideline Lead on Construction Projects, 2011, and would specifically consist of the following:

Type 1 Lead Operations

- Removal of lead-containing coatings with a chemical gel or paste and fibrous laminated cloth wrap.
- Removal of lead-containing coatings or materials using a power tool that has an effective dust collection system equipped with a HEPA filter.
- Removal of lead-containing sheet metal.
- Removal of lead-containing packing, babbit or similar material.
- Removal of lead-containing coatings or materials using non-powered hand tools, other than manual scraping or sanding.
- Soldering.

Type 2A Lead Operations

- Welding or high temperature cutting of lead-containing coatings or materials outdoors. This operation is considered a Type 2A operation only if it is short-term, not repeated, and if the material has been stripped prior to welding or high temperature cutting. Otherwise, it will be considered a Type 3A operation.
- Removal of lead-containing coatings or materials by scraping or sanding using non-powered hand tools.
- Manual demolition of lead-painted plaster walls or building components by striking a wall with a sledgehammer or similar tool.

Type 3A Lead Operations

- Welding or high temperature cutting of lead-containing coatings or materials indoors or in a confined space.
- Burning of a surface containing lead.
- Dry removal of lead-containing mortar using an electric or pneumatic cutting device.
- Removal of lead-containing coatings or materials using power tools without an effective dust collection system equipped with a HEPA filter.
- Removal or repair of a ventilation system used for controlling lead exposure.
- An operation that may expose a worker to lead dust, fume or mist that is not a Type 1, Type 2, or Type 3B operation.

Type 3B Lead Operations

Abrasive blasting of lead-containing coatings or materials.

Lead-painted items may be a hazardous waste. Test lead-painted materials for leachable lead prior to disposal.

Lead-containing items [lead-acid batteries, others] should be recycled when taken out of service or prior to building demolition.

4.3.3 Silica

Construction disturbance of silica-containing products may result in excessive exposures to airborne silica, especially if performed indoors and dry. Cutting, grinding, drilling or demolition of materials containing silica should be completed only with proper respiratory protection and other worker safety precautions that comply with provincial standards or guidelines.

Type 1 Silica Operations

- The drilling of holes in concrete or rock that is not part of a tunnelling operation or road construction.
- Milling of asphalt from concrete highway pavement.
- Charging mixers and hoppers with silica sand (sand consisting of at least 95 per cent silica) or silica flour (finely ground sand consisting of at least 95 percent silica).
- Any other operation at a project that requires the handling of silica-containing material in a way that may result in a worker being exposed to airborne silica.

- Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling.
- Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.

Type 2 Silica Operations

- Removal of silica containing refractory materials with a jackhammer.
- The drilling of holes in concrete or rock that is part of a tunnelling or road construction.
- The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials.
- The use of a power tool to remove silica containing materials.
- Tunnelling (operation of the tunnel boring machine, tunnel drilling, tunnel mesh installation).
- Tuckpoint and surface grinding.
- Dry mortar removal with an electric or pneumatic cutting device.
- Dry method dust cleanup from abrasive blasting operations.
- The use of compress air outdoors for removing silica dust.
- Entry into area where abrasive blasting is being carried out for more than 15 minutes.

Type 3 Silica Operations

- Abrasive blasting with an abrasive that contains ≥ 1 percent silica.
- Abrasive blasting of a material that contains ≥ 1 percent silica.

4.3.4 Mercury

Do not break lamps or separate liquid mercury from components. Recycle and reclaim mercury from fluorescent light tubes when taken out of service. Light tubes are accepted free of charge at many local recycling depots. Liquid mercury is classified as a hazardous waste and must be disposed of in accordance with local regulations.

4.3.5 Ozone Depleting Substances (ODS):

Use appropriate precautions and protect workers using methods that comply with the Federal Halocarbon Regulations, 2003.

4.3.6 Mould

No mould was observed. If mould is uncovered inside wall cavities during hand demolition, use appropriate precautions and protect workers using methods that comply with the Canadian Construction Association (CCA) Mould Guidelines for the Canadian Construction Industry, 2004.

4.3.7 Stored Chemicals:

Use appropriate precautions and protect workers using methods that comply with the Material Safety Data Sheets for stored chemicals.

5.0 LIMITATIONS

The work performed by Pinchin was conducted in accordance with generally accepted engineering or scientific practices current in this geographical area at the time the work was performed. No warranty is either expressed or implied by furnishing written reports or findings. The Client acknowledges that subsurface and concealed conditions may vary from those encountered or inspected. Pinchin can only comment on the environmental conditions observed on the date(s) the survey is performed. The work is limited to those materials or areas of concern identified by the Client or outlined in our proposal. Other areas of concern may exist but were not investigated within the scope of this assignment.

Pinchin makes no other representations whatsoever, including those concerning the legal significance of its findings or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issue, regulatory statutes are subject to interpretation and these interpretations may change over time. Pinchin accepts no responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The liability of Pinchin or our officers, directors, shareholders or staff will be limited to the lesser of the fees paid or actual damages incurred by the Client. Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered (Claim Period), to commence legal proceedings against Pinchin to recover such losses or damage unless the laws of the jurisdiction which governs the Claim Period which is applicable to such claim provides that the applicable Claim Period is greater than two years and cannot be abridged by the contract between the Client and Pinchin, in which case the Claim Period shall be deemed to be extended by the shortest additional period which results in this provision being legally enforceable.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

6.0 REFERENCES

The following legislation and documents were referenced in completing the assessment and this report:

1. Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05.
2. Designated Substances, Ontario Regulation 490/09.
3. Lead on Construction Projects, Ministry of Labour Guidance Document.
4. Ministry of the Environment Regulation, R.R.O. 1990 Reg. 347 as amended.
5. Surface Coating Materials Regulations, SOR/2005-109, Hazardous Products Act.
6. Silica on Construction Projects, Ministry of Labour Guidance Document.
7. Alert – Mould in Workplace Buildings, Ontario Ministry of Labour.

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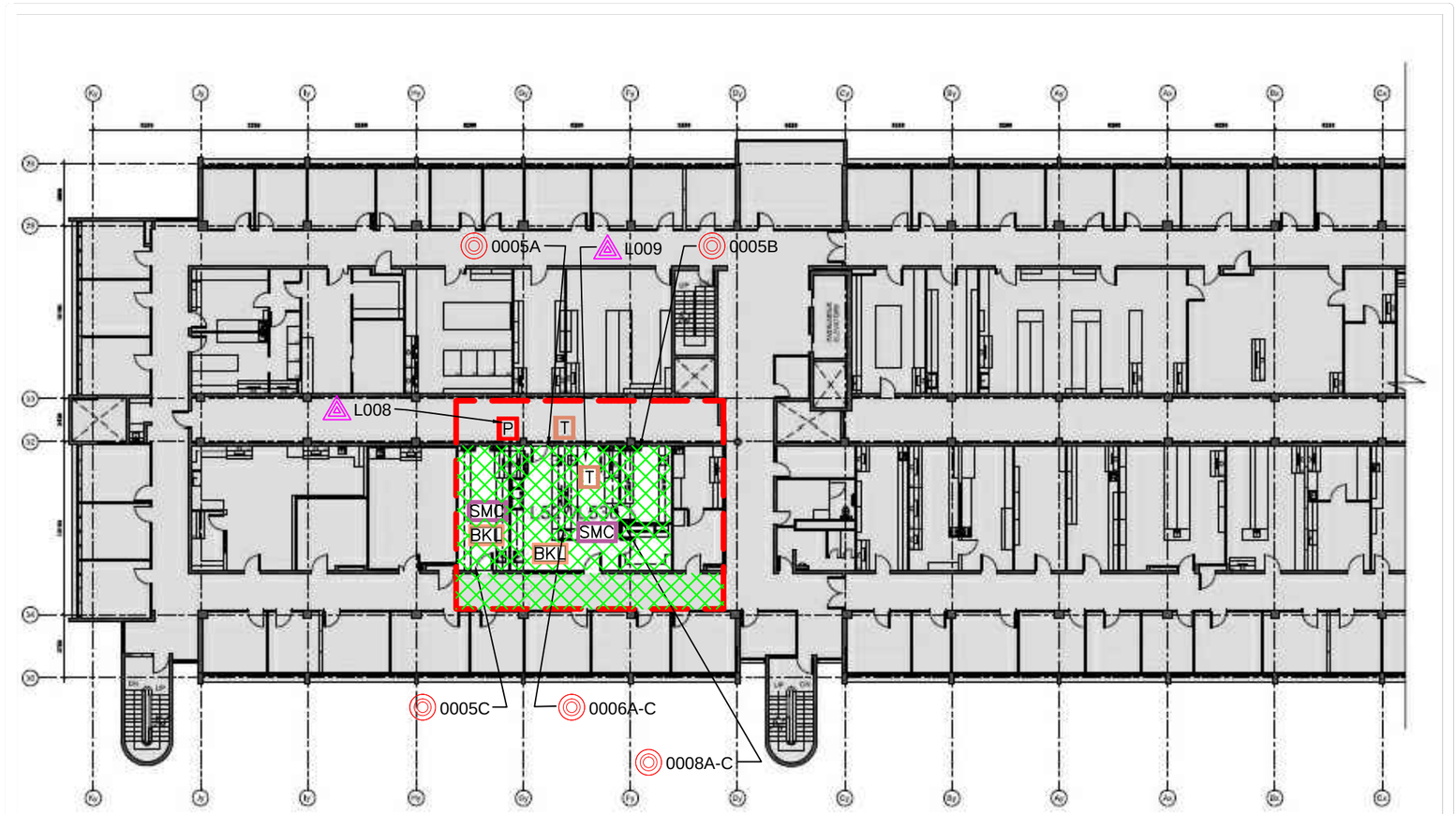
Template: Master Report for Hazardous Materials Assessment Report (Pre-Construction), Haz, December 10, 2014

APPENDIX I

Drawings



PINCHIN

LEGEND:

- ASBESTOS SAMPLE LOCATION
- LEAD SAMPLE LOCATION
- SURVEY BOUNDARY/ASSESSED AREA

ASBESTOS-CONTAINING MATERIALS:

- P — PIPE INSULATION
- T — TRANSITE
- SMC — SEALANTS, MASTIC OR CAULKING
- BKL — BAKELITE
- MI — MECHANICAL INSULATION
- LB — LEAD-CONTATNING BATTERY
- D — DUCT INSULATION
- VINYL FLOOR TILES

NOTE:
LEAD-CONTANING PAINTS, SILICA-CONTANING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
L527 / L530 - A & L BUILDING

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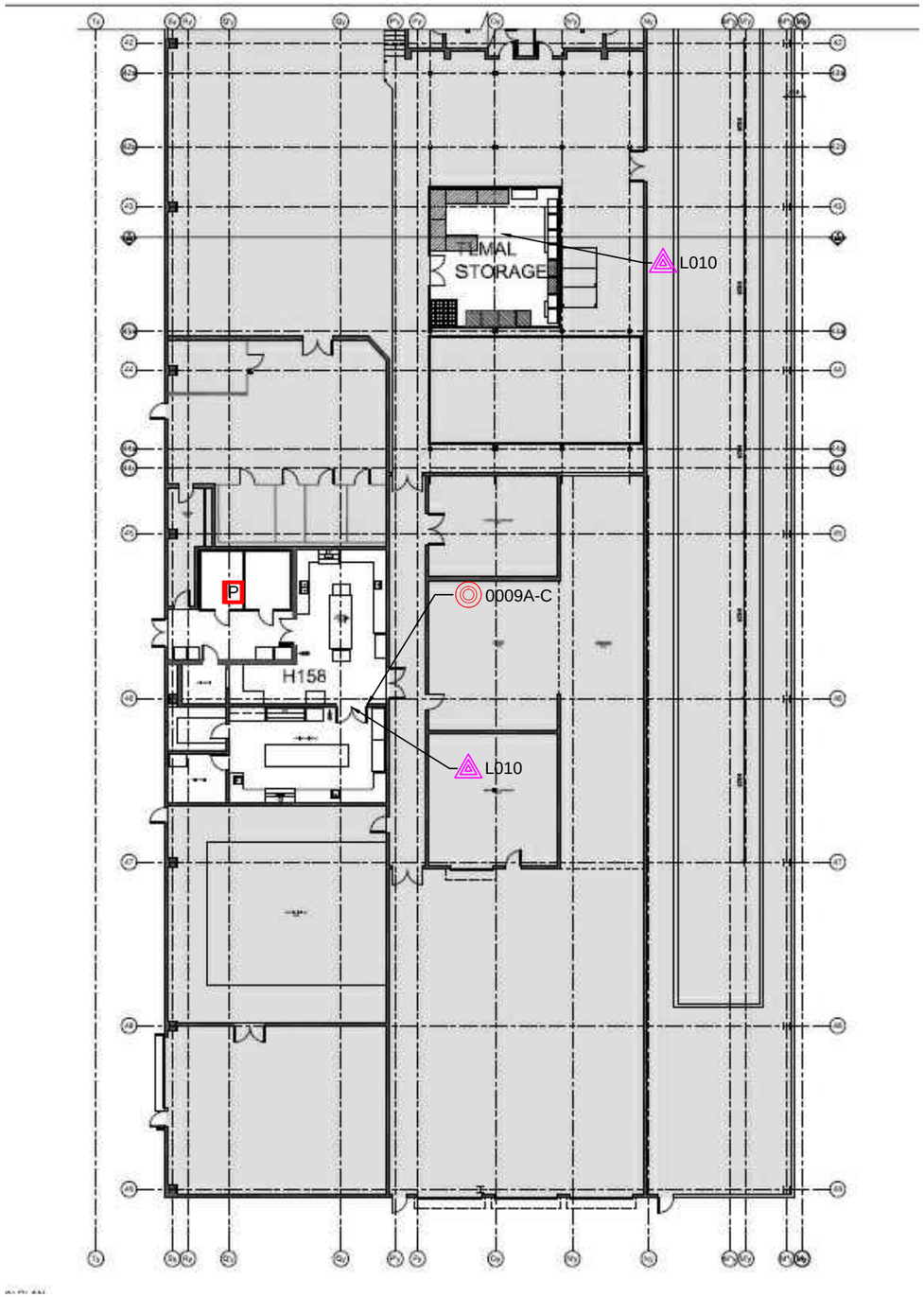
CHECKED BY: LNC	
SCALE: NTS	



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PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
H158 - HYDRAULICS BUILDING

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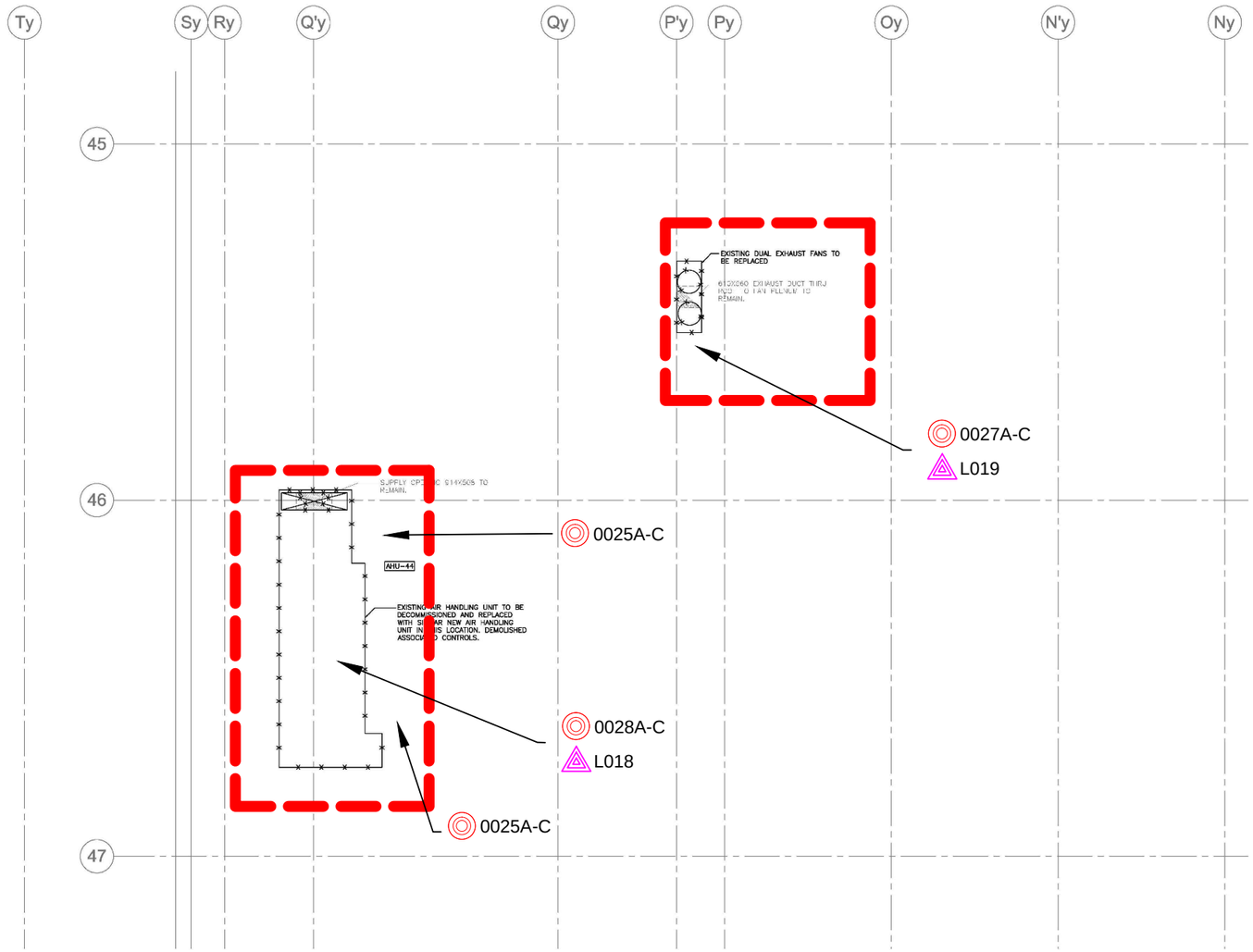

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DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
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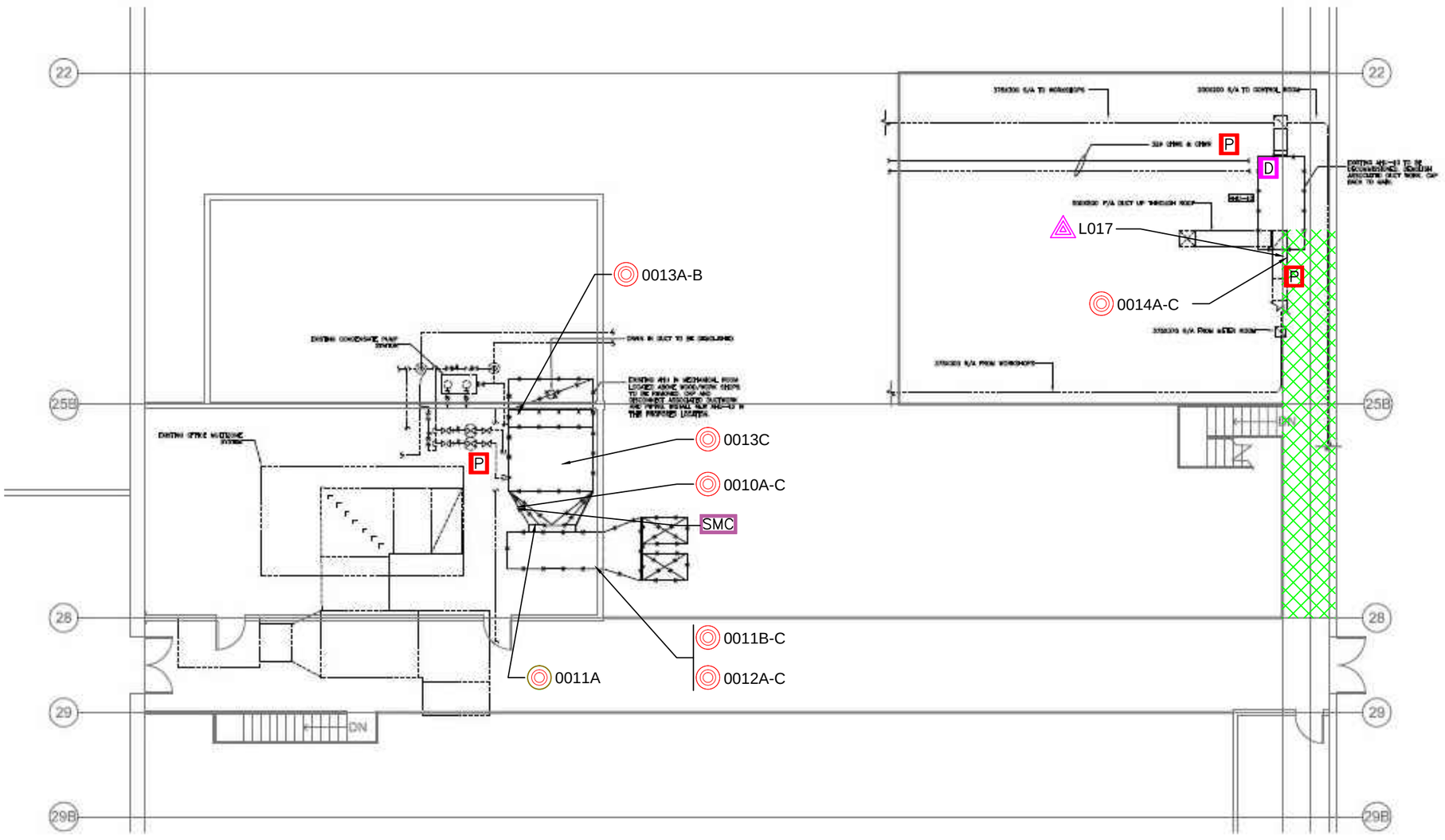

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PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
AHU-43 HYDRAULICS BUILDING

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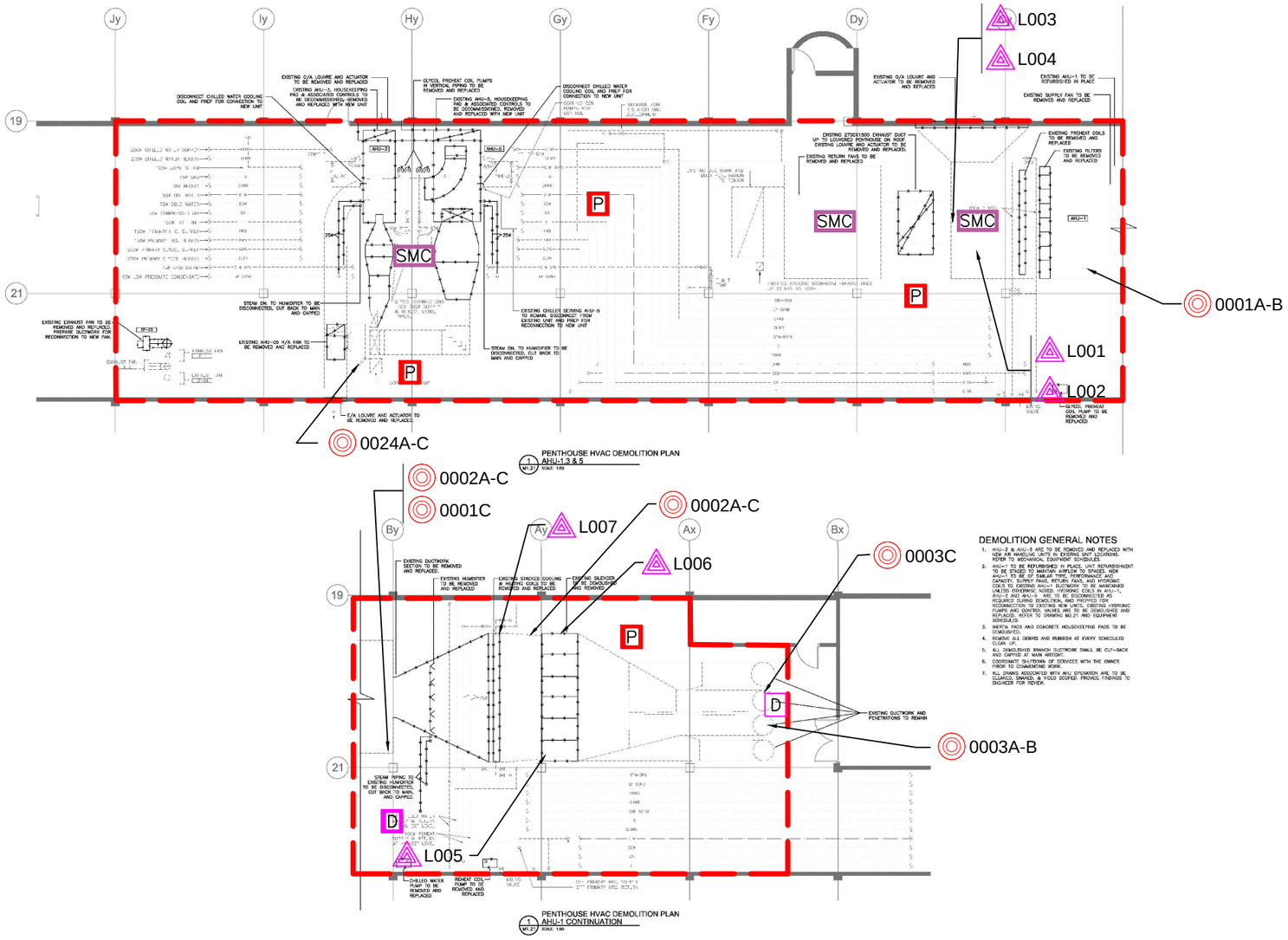

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NOTE:
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CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
AHU-1,3 & 5 - R & D BUILDING

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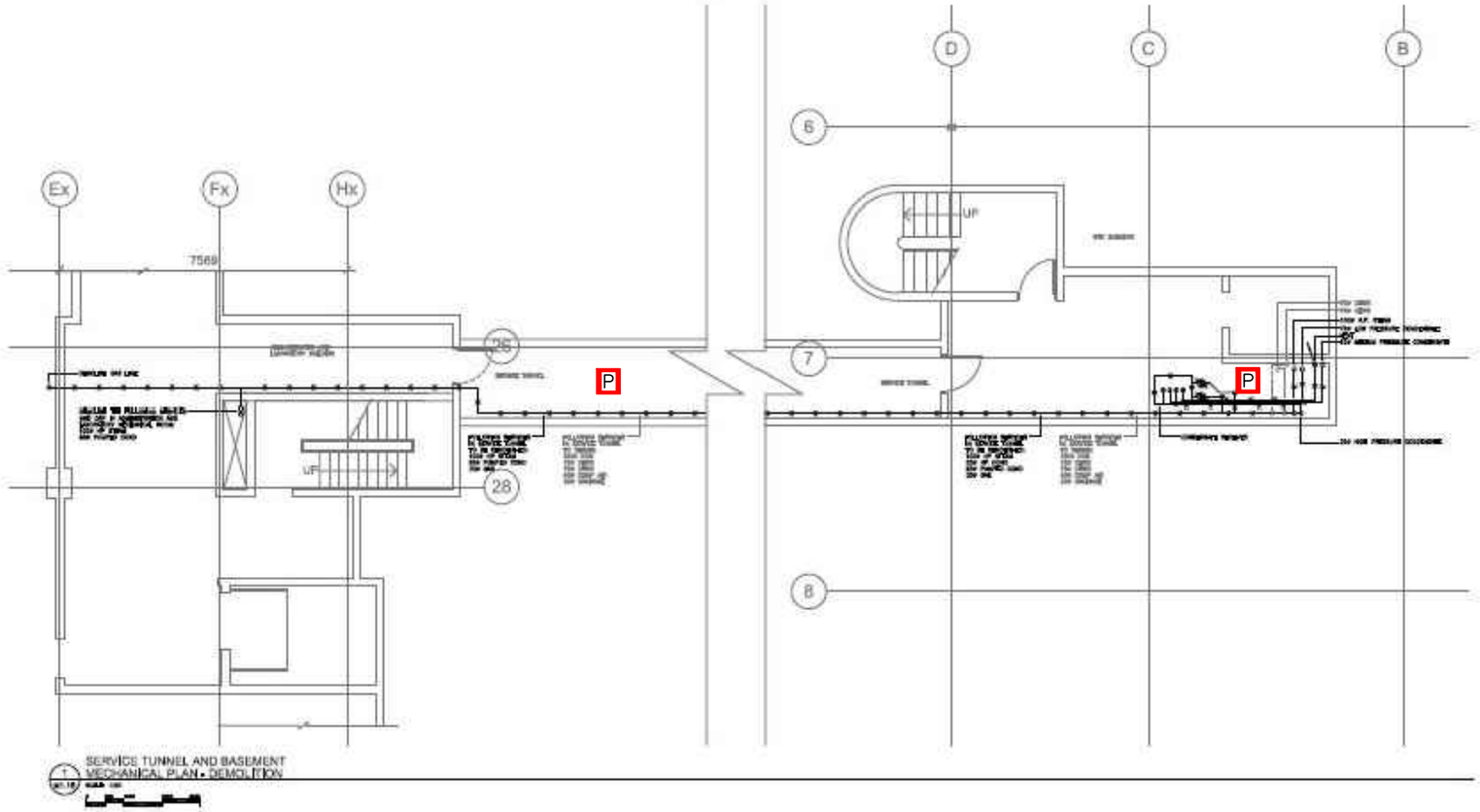

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867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
SERVICE TUNNEL/BASEMENT

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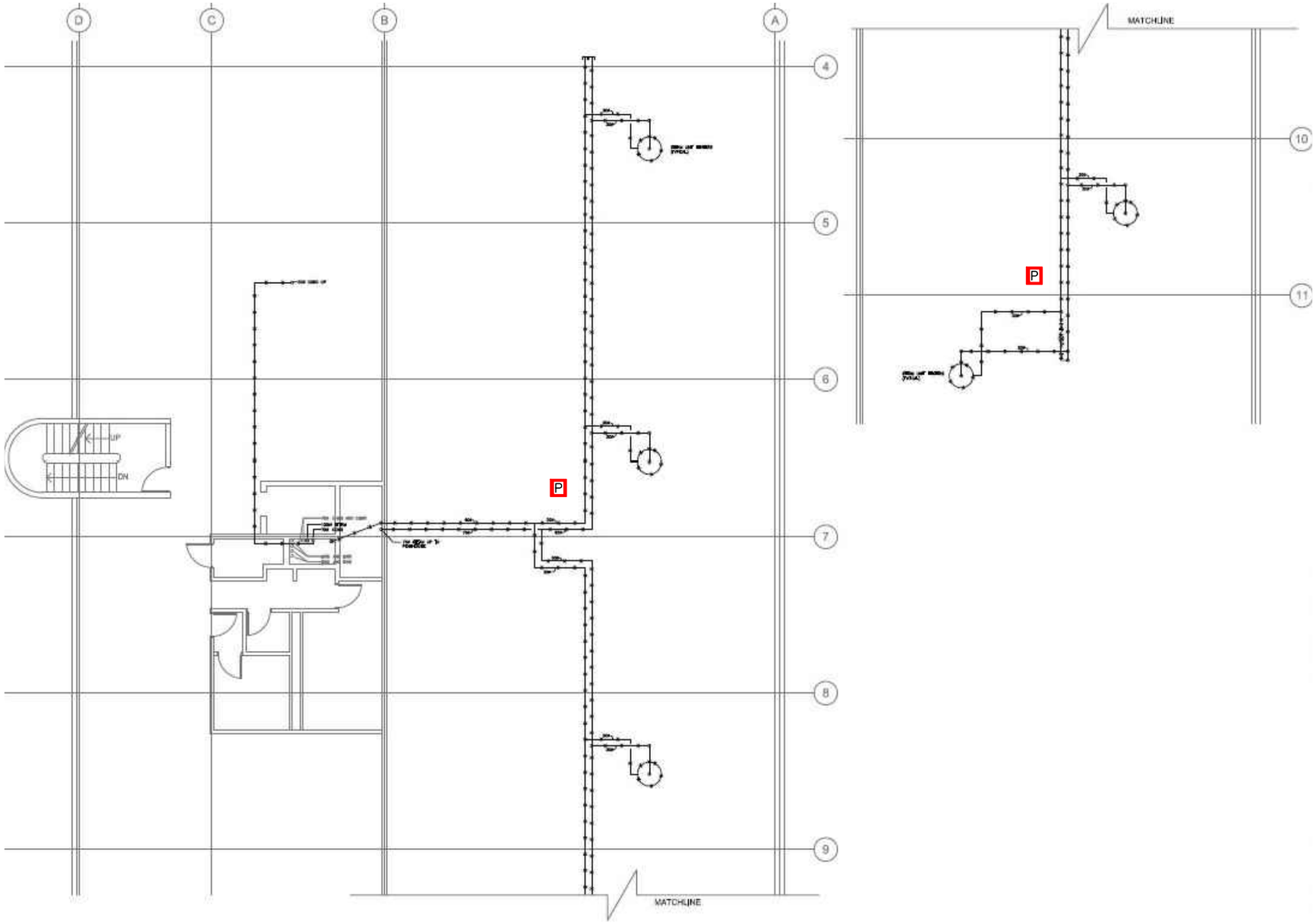

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LEGEND:

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- VINYL FLOOR TILES

NOTE:
LEAD-CONTANING PAINTS, SILICA-CONTANING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
SECOND FLOOR - WTC BUILDING

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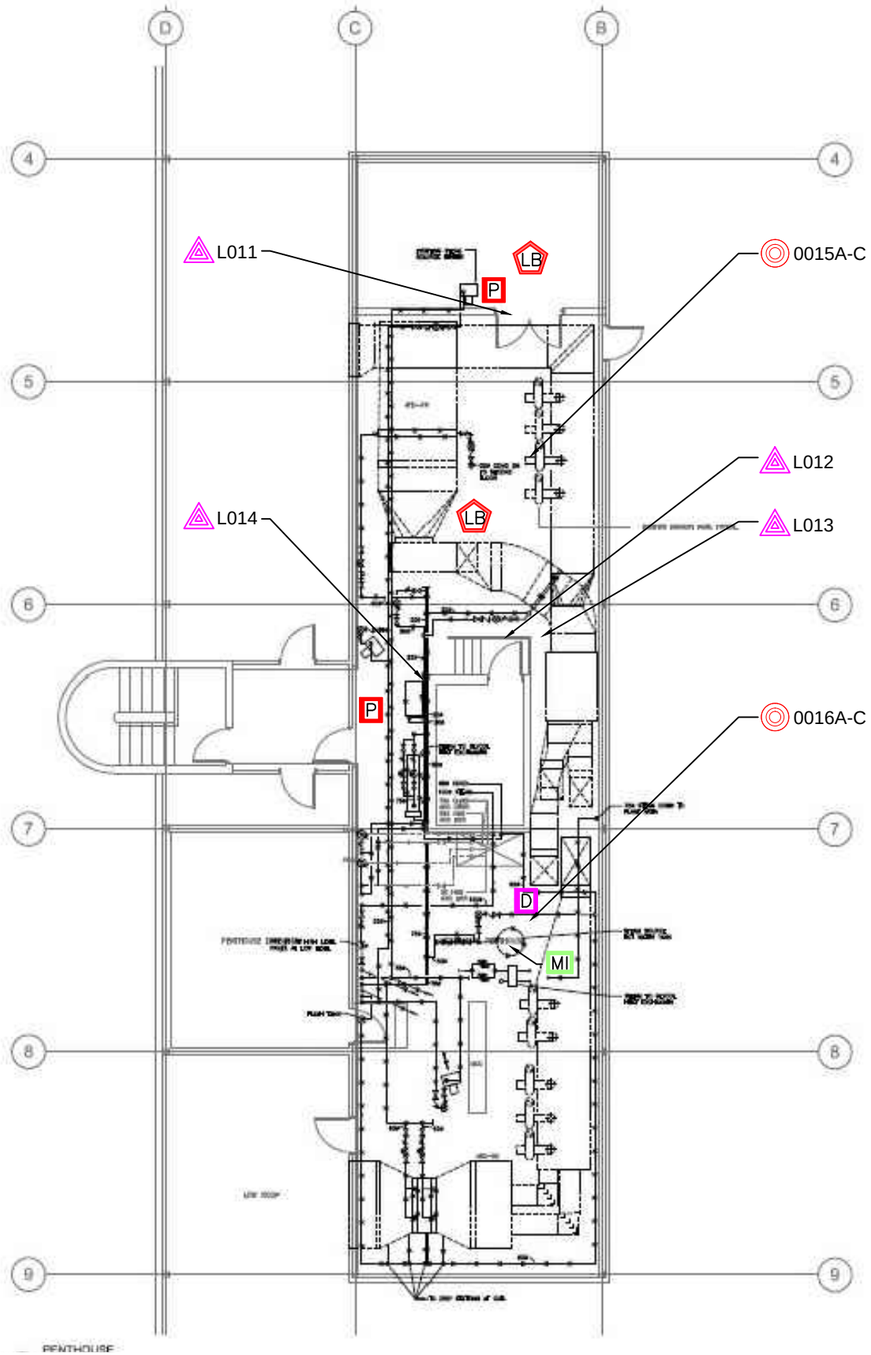

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CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
PENTHOUSE - WTC BUILDING

DATE:	PROJECT # :
JULY 2015	97138.001
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CHECKED BY: LNC	8 OF 8
SCALE: NTS	

APPENDIX II-A

Asbestos Analytical Certificates

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Leslie Cantar
David Niemand

Lab Order ID: 1502586
Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0001A *1502586PLM_1*	Red mastic at joints on System 1, R&D Mechanical Penthouse	**3% Chrysotile**		**97% Other**	Red Non Fibrous Heterogeneous Dissolved
0001B *1502586PLM_2*	Red mastic at joints in System 1, R&D Mechanical Penthouse	**Not Analyzed**			
0001C *1502586PLM_3*	Red mastic at joints in System 1, filter area, R&D Mechanical Penthouse	**Not Analyzed**			
0002A - A *1502586PLM_4*	Foam sealant and yellow adhesive at door into filter area of System 1, R&D Mecha *foam sealant*	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous Dissolved
0002A - B *1502586PLM_49*	Foam sealant and yellow adhesive at door into filter area of System 1, R&D Mecha *adhesive*	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous Dissolved
0002B - A *1502586PLM_5*	Foam sealant and yellow adhesive at door into filter area of System 1, R&D Mecha *foam sealant*	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous Dissolved
0002B - B *1502586PLM_50*	Foam sealant and yellow adhesive at door into filter area of System 1, R&D Mecha *adhesive*	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous Dissolved
0002C - A *1502586PLM_6*	Foam sealant and yellow adhesive at door into filter area of System 1, R&D Mecha *foam sealant*	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous Dissolved

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Charmel Dozier (51)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Leslie Cantar
David Niemand

Lab Order ID: 1502586
Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0002C - B *1502586PLM_51*	Foam sealant and yellow adhesive at door into filter area of System 1, R&D Mecha *adhesive*	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous Dissolved
0003A *1502586PLM_7*	Paper on round ductwork, hot ducts, R&D Penthouse Mechanical Room *unable to separate layers*	**40% Chrysotile**	**10% Fiber Glass**	**50% Other**	Gray Fibrous Heterogeneous Teased
0003B *1502586PLM_8*	Paper on round ductwork, hot ducts, R&D Penthouse Mechanical Room	**Not Analyzed**			
0003C *1502586PLM_9*	Paper on round ductwork, hot ducts, R&D Penthouse Mechanical Room	**Not Analyzed**			
0004A *1502586PLM_10*	Tar at structural penetrations through floor, R&D Penthouse Mechanical Room	**None Detected**	**10% Cellulose**	**90% Other**	Black Fibrous Heterogeneous Dissolved
0004B *1502586PLM_11*	Tar at structural penetrations through floor, R&D Penthouse Mechanical Room	**None Detected**	**10% Cellulose**	**90% Other**	Black Fibrous Heterogeneous Dissolved
0004C *1502586PLM_12*	Tar at structural penetrations through floor, R&D Penthouse Mechanical Room	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous Dissolved
0005A *1502586PLM_13*	White caulking at door frame, Lab L530 at Service Core	**3% Chrysotile**		**97% Other**	White Non Fibrous Heterogeneous Dissolved

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Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0005B *1502586PLM_14*	White caulking at column, Lab L530A	**Not Analyzed**			
0005C *1502586PLM_15*	White caulking at door frame, Lab L527	**Not Analyzed**			
0006A *1502586PLM_16*	White undercoat on sink, Lab L530	**None Detected**		**100% Other**	White Non Fibrous Heterogeneous Dissolved
0006B *1502586PLM_17*	White undercoat on sink, Lab L530	**None Detected**		**100% Other**	White Non Fibrous Heterogeneous Dissolved
0006C *1502586PLM_18*	White undercoat on sink, Lab L530	**None Detected**		**100% Other**	White Non Fibrous Heterogeneous Dissolved
0007A *1502586PLM_19*	Brown putty at window pane of fumehood, Lab L530	**3% Chrysotile**		**97% Other**	Brown Non Fibrous Heterogeneous Dissolved
0007B *1502586PLM_20*	Brown putty at window pane of fumehood, Lab L530	**Not Analyzed**			
0007C *1502586PLM_21*	Brown putty at window pane of fumehood, Lab L530	**Not Analyzed**			

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Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Leslie Cantar
David Niemand

Lab Order ID: 1502586
Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0008A	Brown baseboard mastic, Lab L530	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_22					Dissolved
0008B	Brown baseboard mastic, Lab L530	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_23					Dissolved
0008C	Brown baseboard mastic, Lab L530	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_24					Dissolved
0009A	Yellow baseboard mastic, Lab H158	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous
1502586PLM_25					Dissolved
0009B	Yellow baseboard mastic, Lab H158	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous
1502586PLM_26					Dissolved
0009C	Yellow baseboard mastic, Lab H158	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous
1502586PLM_27					Dissolved
0010A	Brown mastic at joint of abandoned AHU, Equipment Room H245	**3% Chrysotile**		**97% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_28					Dissolved
0010B	Brown mastic at joint of abandoned AHU, Equipment Room H245	**Not Analyzed**			
1502586PLM_29					

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Analyst

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Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

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Attn: Leslie Cantar
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Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0010C *1502586PLM_30*	Brown mastic at joint of abandoned AHU, Equipment Room H245	**Not Analyzed**			
0011A *1502586PLM_31*	Vibration damper on abandoned AHU, Equipment Room H245	**None Detected**	**20% Fiber Glass**	**80% Other**	Beige Fibrous Heterogeneous Ashed
0011B *1502586PLM_32*	Vibration damper on abandoned AHU, Equipment Room H245	**None Detected**	**20% Fiber Glass**	**80% Other**	Beige Fibrous Heterogeneous Ashed
0011C *1502586PLM_33*	Vibration damper on abandoned AHU, Equipment Room H245	**None Detected**	**20% Fiber Glass**	**80% Other**	Beige Fibrous Heterogeneous Ashed
0012A *1502586PLM_34*	Grey caulking at door frame, Equipment Room H245	**None Detected**	**2% Fiber Glass**	**98% Other**	Gray Non Fibrous Heterogeneous Dissolved
0012B *1502586PLM_35*	Grey caulking at door frame, Equipment Room H245	**None Detected**	**2% Fiber Glass**	**98% Other**	Gray Non Fibrous Heterogeneous Dissolved
0012C *1502586PLM_36*	Grey caulking at door frame, Equipment Room H245	**None Detected**	**2% Fiber Glass**	**98% Other**	Gray Non Fibrous Heterogeneous Dissolved
0013A *1502586PLM_37*	Tar on fibreglass insulation within abandoned AHU, Equipment Room H245	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous Dissolved

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Charmel Dozier (51)

Analyst

Approved Signatory

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Leslie Cantar
David Niemand

Lab Order ID: 1502586
Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0013B	Tar on fibreglass insulation within abandoned AHU, Equipment Room H245	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous
1502586PLM_38					Dissolved
0013C	Tar on fibreglass insulation within abandoned AHU, Equipment Room H245	**None Detected**		**100% Other**	Black Non Fibrous Heterogeneous
1502586PLM_39					Dissolved
0014A	Yellow mastic on blue ductwork at AHU 43, Mezzanine adjacent to H241	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous
1502586PLM_40					Dissolved
0014B	Yellow mastic on blue ductwork at AHU 43, Mezzanine adjacent to H241	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous
1502586PLM_41					Dissolved
0014C	Yellow mastic on blue ductwork at AHU 43, Mezzanine adjacent to H241	**None Detected**		**100% Other**	Yellow Non Fibrous Heterogeneous
1502586PLM_42					Dissolved
0015A	Brown caulking at door frame to Roof, WTC Mechanical Penthouse	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_43					Dissolved
0015B	Brown caulking at door frame to Roof, WTC Mechanical Penthouse	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_44					Dissolved
0015C	Brown caulking at door frame to Roof, WTC Mechanical Penthouse	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous
1502586PLM_45					Dissolved

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Charmel Dozier (51)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Leslie Cantar
David Niemand

Lab Order ID: 1502586
Analysis ID: 1502586_PLM
Date Received: 2/10/2015
Date Reported: 2/13/2015

Project: 97138.001, Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	*Lab Notes*				Treatment
0016A	Parging cement on ductwork near pipe chase, WTC Mechanical Penthouse	**30% Chrysotile**		**70% Other**	Gray Fibrous Heterogeneous
1502586PLM_46					Teased
0016B	Parging cement on ductwork near pipe chase, WTC Mechanical Penthouse	**Not Analyzed**			
1502586PLM_47					
0016C	Parging cement on ductwork near pipe chase, WTC Mechanical Penthouse	**Not Analyzed**			
1502586PLM_48					

Charmel Dozier (51)

Analyst

Approved Signatory

Bulk Asbestos Analysis
by Transmission Electron Microscopy

Semi-Quantitative
Chatfield SOP 1988-02 Rev. 1

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Damian Palus
Chris Mego

Project: 97138.001 PWGSC

Lab Order ID: 1505361
Analysis ID: 1505361_TBS
Date Received: 3/20/2015
Date Reported: 3/21/2015

Sample ID	Description	Organic	Acid Sol.	Asbestos		LCL-UCL
Lab Sample ID	*Lab Notes*	*(Wt. %)*	*(Wt. %)*	*(Wt. %)*		*(Wt. %)*
0017	12" x 12" vinyl floor tile, white with grey specks, L530	20.%	60.%	16 %	Chrysotile	15% - 18%
1505361TBS_1						
0018	12" x 12" vinyl floor tile, white with grey streaks, corridor	18%	74%	None Detected		
1505361TBS_2						

Russell Shelton (2)

Analyst

Approved Signatory

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0019A *1509550PLM_1*	Rough plaster on wall at duct penetrations, South Service Corridor, 7th Floor *single layer*	**None Detected**		**80% Other** **20% Perlite**	Gray Non Fibrous Heterogeneous Crushed
0019B *1509550PLM_2*	Rough plaster on wall at duct penetrations, South Service Corridor, 7th Floor *single layer*	**None Detected**		**80% Other** **20% Perlite**	Gray Non Fibrous Heterogeneous Crushed
0019C *1509550PLM_3*	Rough plaster on wall at duct penetrations, South Service Corridor, 7th Floor *single layer*	**None Detected**		**80% Other** **20% Perlite**	Gray Non Fibrous Heterogeneous Crushed
0020A *1509550PLM_4*	Brown mastic on joints of redundant metal exhaust duct, Lab L435	**2% Chrysotile**		**98% Other**	Brown Non Fibrous Homogeneous Ashed
0020B *1509550PLM_5*	Brown mastic on joints of redundant metal exhaust duct, Lab L435	**Not Analyzed**			
0020C *1509550PLM_6*	Brown mastic on joints of redundant metal exhaust duct, Lab L435	**Not Analyzed**			
0021A *1509550PLM_7*	Parging cement on square ductwork, AHU 27, Third Floor Mechanical Room	**30% Chrysotile**		**70% Other**	White Fibrous Homogeneous Teased
0021B *1509550PLM_8*	Parging cement on square ductwork, AHU 27, Third Floor Mechanical Room	**Not Analyzed**			

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Sharon Donald (30)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

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NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0021C *1509550PLM_9*	Parging cement on square ductwork, AHU 27, Third Floor Mechanical Room	**Not Analyzed**			
0022A *1509550PLM_10*	Putty at pipe penetrations into AHU 27, Third Floor Mechanical Room	**None Detected**	**5% Cellulose**	**95% Other**	Gray Non Fibrous Homogeneous Dissolved
0022B *1509550PLM_11*	Putty at pipe penetrations into AHU 27, Third Floor Mechanical Room	**None Detected**	**5% Cellulose**	**95% Other**	Gray Non Fibrous Homogeneous Dissolved
0022C *1509550PLM_12*	Putty at pipe penetrations into AHU 27, Third Floor Mechanical Room	**None Detected**	**5% Cellulose**	**95% Other**	Gray Non Fibrous Homogeneous Dissolved
0023A *1509550PLM_13*	Brown caulking at seams of AHU 28, Third Floor Mechanical Room	**1% Chrysotile**		**99% Other**	Brown, Green Non Fibrous Heterogeneous Dissolved
0023B *1509550PLM_14*	Brown caulking at seams of AHU 28, Third Floor Mechanical Room	**Not Analyzed**			
0023C *1509550PLM_15*	Brown caulking at seams of AHU 28, Third Floor Mechanical Room	**Not Analyzed**			
0024A *1509550PLM_16*	Brown caulking at joints of exhaust for AHU 5, Third Floor R&D Mechanical Penth	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed

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NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0024B *1509550PLM_17*	Brown caulking at joints of exhaust for AHU 5, Third Floor R&D Mechanical Penth	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0024C *1509550PLM_18*	Brown caulking at joints of exhaust for AHU 5, Third Floor R&D Mechanical Penth	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0025A *1509550PLM_19*	Black tar at gas pipe penetration, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0025B *1509550PLM_20*	Black tar at gas pipe penetration, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0025C *1509550PLM_21*	Black tar at gas pipe penetration, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0026A *1509550PLM_22*	Black mastic at corners of duct seams, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0026B *1509550PLM_23*	Black mastic at corners of duct seams, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0026C *1509550PLM_24*	Black mastic at corners of duct seams, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed

Sharon Donald (30)

Analyst

Approved Signatory

Bulk Asbestos Analysis

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NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID / *Lab Sample ID*	Description / *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes / Treatment
0027A / *1509550PLM_25*	Grey caulking at electrical wiring penetration, Roof of Hydraulics at AHU 44 exhaust	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0027B / *1509550PLM_26*	Grey caulking at electrical wiring penetration, Roof of Hydraulics at AHU 44 exhaust	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0027C / *1509550PLM_27*	Grey caulking at electrical wiring penetration, Roof of Hydraulics at AHU 44 exhaust	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0028A / *1509550PLM_28*	Grey caulking on exterior joints of AHU 44, Roof of Hydraulics	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0028B / *1509550PLM_29*	Grey caulking on exterior joints of AHU 44, Roof of Hydraulics	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0028C / *1509550PLM_30*	Grey caulking on interior joints of AHU 44, Roof of Hydraulics	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed

Sharon Donald (30)

Analyst

Approved Signatory

APPENDIX II-B

Lead Analytical Certificates

Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy
EPA SW-846 3050B/6010C/7420

AIHA LAP, LLC ACCREDITED LABORATORY
ENVIRONMENTAL LEAD
ISO/IEC 17025:2005
www.aihaaccreditedlabs.org
LAB #173190

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
David Niemand

Lab Order ID: 1502454
Analysis ID: 1502454_PBP
Date Received: 2/9/2015
Date Reported: 2/13/2015

Project: 97138.001 PWGSC 867 Lakeshore Road Burlington DSUB

Sample ID *Lab Sample ID*	Description *Lab Notes*	Mass *(g)*	Concentration *(ppm)*	Concentration *(% by weight)*
L001 1502454PBP_1	Blue paint - System 1, R&D Mechanical Penthouse	0.0527	42000	**4.2%**
L002 1502454PBP_2	Red paint - Steel structure, System 1, R&D Mechanical Penthouse	0.0650	100000	**10.%**
L003 1502454PBP_3	Green paint - Steel at concrete pad, System 1, R&D Mechanical Penthouse	0.0828	55000	**5.5%**
L004 1502454PBP_4	Grey paint - Metal fan housing, System 1, R&D Mechanical Penthouse	0.0339	1100	**0.11%**
L005 1502454PBP_5	Silver paint - Steel within System 1, R&D Mechanical Penthouse	0.0535	940	**0.094%**
L006 1502454PBP_6	Green paint - outside of System 1, R&D Mechanical Penthouse	0.0516	110000	**11%**
L007 1502454PBP_7	Yellow paint - System 1, pipes, R&D Mechanical Penthouse	0.0512	12000	**1.2%**
L008 1502454PBP_8	Orange paint - Fume hood, Fifth Floor, Lab L530	0.0145	85000	**8.5%**
L009 1502454PBP_9	White paint - Block wall, Fifth Floor, Lab L531	0.0810	500	**0.050%**
L010 1502454PBP_10	Light blue paint - Metal door, First Floor, H158	0.0667	< 60.	**< 0.006%**

Unless otherwise noted blank sample correction was not performed on analytical results. Scientific Analytical Institute participates in the AIHA IHPAT program. IHPAT Laboratory ID: 173190. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. Analytical uncertainty available upon request. The quality control samples run with the samples in this report have passed all EPA required specifications unless otherwise noted. RL: (Report Limit for an undiluted 50ml sample is 4µg Total Pb).

Daniel Olson (14)
Analyst

Laboratory Director

Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy
EPA SW-846 3050B/6010C/7420

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Customer: Pinchin Ltd.
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Attn: Leslie Cantar
David Niemand

Lab Order ID: 1502454
Analysis ID: 1502454_PBP
Date Received: 2/9/2015
Date Reported: 2/13/2015

Project: 97138.001 PWGSC 867 Lakeshore Road Burlington DSUB

Sample ID *Lab Sample ID*	Description *Lab Notes*	Mass *(g)*	Concentration *(ppm)*	Concentration *(% by weight)*
L011 1502454PBP_11	Orange paint - Metal door, Mechanical Penthouse, WTC	0.0524	27000	**2.7%**
L012 1502454PBP_12	Black paint - Steel structure, Mechanical Penthouse, WTC	0.0359	4700	**0.47%**
L013 1502454PBP_13	Off-white paint - Steel structure, Mechanical Penthouse, WTC	0.0662	2500	**0.25%**
L014 1502454PBP_14	Grey paint - Concrete floor, Mechanical Penthouse, WTC	0.0713	560	**0.056%**

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Daniel Olson (14)

Analyst | **Laboratory Director**

Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy
EPA SW-846 3050B/6010C/7420

AIHA LAP, LLC ACCREDITED LABORATORY ENVIRONMENTAL LEAD ISO/IEC 17025:2005 www.aihaaccreditedlabs.org LAB #173190

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509441
Analysis ID: 1509441_PBP
Date Received: 5/15/2015
Date Reported: 5/21/2015

Project: 97138.001 PWGSC 867 Lakeshore Road Burlington DSUB

Sample ID *Lab Sample ID*	Description *Lab Notes*	Mass *(g)*	Concentration *(ppm)*	Concentration *(% by weight)*
L015 1509441PBP_1	Yellow paint on pipes at AHU 27, Third Floor Mechanical Room	0.0524	160000	**16%**
L016 1509441PBP_2	Green paint on AHU 27, Third Floor Mechanical Room	0.0667	140000	**14%**
L017 1509441PBP_3	White paint on steel beam, Hydraulics Mezzanine Level at AHU 43	0.0646	2700	**0.27%**
L018 1509441PBP_4	Grey paint on metal exterior of AHU 44, Roof of Hydraulics	0.0596	100	**0.010%**
L019 1509441PBP_5	Grey paint on metal exhaust for AHU 44, Roof of Hydraulics	0.0677	< 59	**< 0.006%**
L020 1509441PBP_6	White paint on steel column supporting Mezzanine, Hydraulics Open Area near Lab H158	0.0596	< 67	**< 0.007%**
L021 1509441PBP_7	Black paint on exterior metal cladding, Roof at WTC Penthouse	0.0501	270	**0.027%**

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Daniel Olson (7)
Analyst

Laboratory Director

APPENDIX II-C

Mould Analytical Certificates

PINCHIN

2470 Milltower Court
Mississauga, ON L5N 7W5
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THE PINCHIN GROUP

AIHA LAP, LLC
ACCREDITED LABORATORY
ENVIRONMENTAL MICROBIOLOGY
ISO/IEC 17025:2005
www.aihaaccreditedlabs.org
LAB #168835

Pinchin Environmental Microbiology Laboratory
Certificate of Analysis

CUSTOMER: Leslie Cantar, David Niemand
COMPANY: Pinchin Ltd.
ADDRESS: 875 Main Street W., Unit 11
Hamilton, ON L8S 4P9

PROJECT NAME: PWGSC CCIW Renovations
PROJECT NO.: 97138.001
TYPE OF SAMPLE(S): TAPE-LIFT
DATE COLLECTED: February 5, 2015
DATE ANALYSED: February 10, 2015
ANALYST: Rawah Naeeim, M.Sc.
TITLE: Environmental Microbiologist
REVIEWER: Partinder Puri, B.Sc.
TITLE: Environmental Microbiologist

LAB REFERENCE NO.: m62574
SAMPLE CONDITION: Acceptable
DATE RECEIVED: February 9, 2015
DATE REPORTED: February 10, 2015

Method of Analysis: Analysis of Bulk and Tape-lift Samples by Direct Microscope Examination (SOP: DME-BLK-004, December 17, 2013)

This SOP is based on methods described in: "AIHA's Field Guide for Determination of Biological Contaminants in Environmental Samples", "Samson et al's Food and Indoor Fungi", and the "IRRST method 360". Bulk samples are scanned under a stereomicroscope for the presence of mould growth; cellotape samples taken from these are mounted on glass slides and examined under light microscope at X400, X600 (630) or X1000 magnifications as appropriate. Moulds are identified to the genus using keys in relevant books and literature. Mould growth is assessed as Heavy, Moderate or Slight by examining the mycelium cover on the sample and/or the slide preparations. Some moulds may be difficult to identify from bulk samples and these are reported as "Unidentified mould". Spores observed in the absence of an established mycelium are identified whenever possible and rated as "few" for 5-50 spores or "masses" for >50 spores. Results are not corrected for blanks. Estimation of uncertainty is provided upon request.

COMMENTS/OBSERVATIONS (IF ANY):

Notes: 1. The result(s) relate only to the sample(s) tested.
2. This test report shall not be reproduced except in full, without written approval of the laboratory.
3. Services are subject to Pinchin Ltd. Standard Terms and Conditions for Laboratory Services.

PINCHIN

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ACCREDITED LABORATORY
ENVIRONMENTAL MICROBIOLOGY
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www.aihaaccreditedlabs.org
LAB #158835

Pinchin Environmental Microbiology Laboratory

Certificate of Analysis

CUSTOMER: Leslie Cantar, David Niemand
PROJECT NAME: PWGSC CCIW Renovations
LAB REFERENCE NO: m62574
PROJECT NO.: 97138.001
DATE ANALYSED: February 10, 2015
ANALYST: Rawah Naeeim, M.Sc.

RESULTS FOR TAPE-LIFT DME ANALYSIS

Customer Sample No.	Lab Sample ID.	Description	Mould Identified, in Rank Order	Comments (if any)
B1063875	m62574-1	Stained steam piping near pipe chase, WTC mechanical penthouse	No mould detected	
B1065769	m62574-2	Blank	No mould detected	

Signature of Analyst:

APPENDIX III
Methodology

1.0 GENERAL

Pinchin conducts a room-by-room survey (rooms, corridors, service areas, exterior, etc.) to identify the hazardous building materials as defined by the scope.

Information regarding the approximate quantity, location, and condition of hazardous building materials encountered and visually estimated quantities are recorded. The locations of any samples collected are recorded on small-scale plans.

As-built drawings and previous reports are referenced where provided.

1.1 Limitations on Scope

The assessment excludes the following:

- Owner or occupant articles (e.g. stored items, furniture, appliances, etc.);
- Underground materials or equipment (e.g. vessels, drums, underground storage tanks, pipes, etc.);
- Building envelope, structural components, inaccessible or concealed materials or other items where sampling may cause consequential damage to the property.
- Energized systems (e.g. internal boiler components, elevators, mechanical or electrical components);
- Controlled products (e.g. stored chemicals, operational or process-related substances); and
- Materials not typically associated with construction (e.g. settled dust, spills, residual contamination from prior spills, etc.).

The assessment includes limited demolition of wall and ceiling finishes (drywall or plaster) to view concealed conditions at representative areas as permitted by the current building use. Limited destructive testing of flooring is conducted where possible (under carpets or multiple layers of flooring). Demolition of masonry walls (chases, shafts etc.), structural items or exterior building finishes is not conducted.

1.2 Asbestos

Pinchin conducts an inspection for the presence of friable and non-friable asbestos-containing materials (ACM). A friable material is a material that when dry can be crumbled, pulverized or powdered by hand pressure.

A separate set of samples is collected of each type of homogenous material suspected to contain asbestos. A homogenous material is defined by the US EPA[1] as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material. The homogeneous materials are determined by visual examination, available information on the phases of the construction and prior renovations.

Pinchin collects samples at a rate that is in compliance with Table 1 of O.Reg. 278/05.

The sampling strategy is also based on known ban dates and phase out dates of the use of asbestos; sampling of certain building materials is not conducted after specific construction dates. In addition, to be conservative, several years past these dates are added to account for some uncertainty in the exact start/finish date of construction and associated usage of ACM.

In some cases, manufactured products such as asbestos cement pipe are visually identified without sample confirmation.

Pinchin conducts limited demolition of masonry block walls (core holes) to investigate for loose fill insulation. The core holes are temporarily patched with expanding foam.

Flooring mastic/adhesive and leveling compounds are only sampled and analyzed if present on the underside of flooring samples (vinyl floor tile and vinyl sheet flooring).

Pinchin submits the bulk samples to a NVLAP[2] accredited laboratory for analysis. The analysis is performed in accordance with Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, July 1993.

Vinyl floor tiles were analyzed by TEM Chatfield method where they were noted as non-detect by the EPA/600/R-93/116 method.

The asbestos analysis is completed using a stop positive approach. Only one result of greater than the regulated criteria (0.5%) is required to determine that a material is asbestos-containing, but all samples must be analyzed to conclusively determine that a material is non-asbestos. The laboratory stops analyzing samples from a homogeneous material once a result greater than the regulated criteria is detected in any of the samples of that material. All samples of a homogeneous material are analyzed if no asbestos is detected. In some cases, all samples are analyzed in the sample set regardless of result. Where building materials are described in the report as non-asbestos, or described as containing no

1 Environmental Protection Agency
2 National Voluntary Laboratory Accreditation Program

asbestos, this is subject to the limitations of the analytical method used, and should be understood to mean no asbestos was detected.

Asbestos materials are evaluated in order to make recommendations regarding remedial work. This includes friability, condition and efficiency and practicality of the work.

1.3 Lead

Pinchin collects samples of distinctive paint finishes and surface coatings present in more than a limited application, where removal of the paint is possible. Pinchin collects samples by scraping the painted finish to include base and covering applications. Drawings included show sample locations.

Analysis for lead in paints or surface coatings is performed in accordance with EPA Method No. 3050B/Method No. 7420; flame atomic absorption at an accredited laboratory.

For this report, all paints containing lead at a concentration of 0.009% or greater are discussed. Paint and surface coatings are evaluated for condition.

Lead building products (e.g. batteries, lead sheeting, flashing) are identified by visual observation only.

1.4 Silica

Pinchin identifies building materials suspected of containing crystalline silica (e.g. concrete, cement, tile, brick, masonry, mortar) by knowledge of current and historic applications and visual inspection only. Pinchin does not perform sampling of these materials for laboratory analysis of crystalline silica content.

1.5 Mercury

Building materials/products/equipment (e.g. thermostats, barometers, pressure gauges, light tubes), suspected to contain mercury were identified by visually inspection only. Dismantling of equipment suspected of containing mercury was not performed. Sampling of these materials for laboratory analysis of mercury content was not performed.

Mercury spills or damaged mercury-containing equipment was recorded where observed.

1.6 Polychlorinated Biphenyls

Pinchin determines the potential for light ballast and wet transformers to contain PCBs based on the age of the building, a review of maintenance records and examination of labels or nameplates on equipment, where present and accessible. The information is compared to known ban dates of PCBs and Environment Canada publications.

Dry type transformers are presumed to be free of dielectric fluids and hence non-PCB.

Pinchin records spills or leakage of suspect PCB-containing fluids where observed or identified in historical documents.

Fluids (mineral oil, hydraulic or Askarel) in transformers or other equipment are not sampled for PCB content.

Pinchin decides to sample exterior caulking or sealants for PCBs based on the date of construction or installation. Caulking installed after 1985 is presumed to be free of PCBs and hence not sampled. If sampled, analysis for PCBs is performed using an ASTM[3] test method appropriate to the sample matrix at an accredited laboratory.

1.7 Ozone Depleting Substances (ODS)

Pinchin determines the potential presence of ODS (chlorofluorocarbon, hydrochlorofluorocarbon, hydrofluorocarbon, halon, etc.) in air conditioning units, chillers, commercial coolers and fire suppression systems by visual inspection of manufactures' labels or plates, maintenance records, or log books, etc.

Domestic type equipment such as window mounted and small central air conditioners, refrigerators, and freezers are not evaluated for the presence of ODS.

1.8 Visible Mould

Pinchin identifies the presence of mould if visibly present in a significant quantity on exposed building surfaces. If any mould growth is concealed within wall cavities it is not addressed in this assessment.

1.9 Others

The remaining hazardous materials required to be reviewed included the following:

- Ozone-depleting substances
- Urea formaldehyde foam insulation
- Fuel, oil and/or waste oil storage
- Chemical storage
- Hazardous film or residue within the ducts
- Radioactive materials

[3] American Society for Testing and Materials

The review of these materials only included a visual inspection. Pinchin heavily relied on the information provided by the Client for radioactive materials and chemical storage areas, and chemicals used in the Labs which can create hazardous films or residue within ducts.

APPENDIX IV

Photographs

Asbestos-containing parging cement debris on ductwork of abandoned AHU, Equipment Room H245

Asbestos-containing magnesia block insulation on condensate pipe straight, Service Core at Laboratory L527

Asbestos-containing parging cement insulation on fitting, Hydraulics Mezzanine Catwalk/Corridor Mechanical Area at Offices

Damaged asbestos-containing parging cement pipe fittings, WTC Mechanical Penthouse

Damaged asbestos-containing parging cement on pipe fittings, Tunnel to WTC at CCIW

Asbestos-containing parging cement on insulated ductwork, Hydraulics Mezzanine Catwalk/Corridor Mechanical Area at Offices

Damaged asbestos-containing parging cement on insulated ductwork, WTC Mechanical Penthouse

Transite board lining acid/base cabinet below fume hood, Laboratory L530

Transite exhaust serving Laboratory L530, Adjacent Service Core

Asbestos-containing white caulking at door frame, Laboratory L530

Non-asbestos black mastic on fibreglass insulation within abandoned AHU, Equipment Room H245

Non-asbestos brown baseboard mastic, Laboratory L530

Non-asbestos brown caulking at door frame, WTC Mechanical Penthouse

Non-asbestos tar at floor penetrations, R&D Mechanical Penthouse at System 1

PWGSC PROJECT # R.073578.001 - APPENDIX B

FINAL

Designated Substances and Hazardous Materials Survey

867 Lakeshore Road,
Burlington, ON

Prepared for:

Public Works Government Services Canada
4900 Yonge Street, 11 Floor
Toronto, Ontario M2N 6A6

Attention: Mei Ling Chen
Environmental Specialist

July 15, 2015

Pinchin File: 97138.001

MEMBER OF
THE PINCHIN GROUP

Issued to:	**Public Works Government Services Canada**
Contact:	**Mei Ling Chen** **Environmental Specialist**
Issued on:	**July 15, 2015**
Pinchin file:	**97138.001**
Issuing Office:	**875 Main Street W., Unit 11, Hamilton, ON L8S 4P9**
Primary Contact:	**Damian Palus, Operations Manager**

Author:
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Operations Manager
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EXECUTIVE SUMMARY

Public Works Government Services Canada (Client) retained Pinchin Ltd. (Pinchin) on behalf of Environment Canada to conduct a designated substances and hazardous materials survey of specific areas at the Canada Centre for Inland Waters located at 867 Lakeshore Road, Burlington, ON. The assessment was performed on May 13, 2015. A second assessment was performed June 25, 2015 for additional areas added to the scope of work.

The objective of the assessment was to identify specified hazardous building materials in preparation for building renovation. The results of this assessment are intended for use with a properly developed scope of work and performance specification.

The assessed area was limited to the areas of the site as shown highlighted on the drawings in Appendix I. The building was occupied at the time of the assessment work.

SUMMARY OF FINDINGS

Asbestos: Asbestos-containing materials (ACM) were confirmed to be present as follows:

- Parging cement insulation on pipe fittings
- Magnesia block insulation on limited pipe straights
- Parging cement on insulated ductwork
- Transite fume hood and cabinet lining
- Transite fume hood exhaust ductwork
- Vinyl floor tiles
- Vinyl sheet flooring
- Brown mastic on and in air handling units and ductwork
- White interior caulking
- Brown putty on fume hoods
- Bakelite countertops
- Built-up roofing (presumed)

Lead: Lead was confirmed present in select paints/surface coatings and is present in emergency light batteries.

Silica: Crystalline silica is present in concrete, mortar, masonry, ceramics, etc., where present in the assessed area.

Mercury: Mercury vapour is present in fluorescent lamps throughout the assessed area.

Polychlorinated Biphenyls (PCBs): Suspect PCB-containing equipment and light ballasts were not found.

Ozone Depleting Substances (ODS): ODS were not found within the assessed area.

Mould: Mould-impacted materials were not found.

Stored Chemicals: Chemicals are present in minor quantities within the laboratories.

Other Hazardous Materials: Other hazardous materials including urea formaldehyde foam insulation, fuel or waste oil, hazardous duct residue (perchloric or picric acid), and radioactive materials were not observed during the assessment.

SUMMARY OF RECOMMENDATIONS

The following is a summary of significant recommendations; refer to the body of the report for detailed recommendations.

1. Remove asbestos-containing materials which will be affected by renovation work.
2. Remove mercury-containing lamps prior to demolition or if disturbed by renovation work.
3. Follow appropriate safe work procedures when handling or disturbing lead and silica.
4. Regardless of the planned work, remediate the damaged asbestos-containing parging cement on insulated ductwork and the flaking lead-containing paint, as outlined in Section 4.2.

Please refer to Section 4.0 of this report for detailed recommendations regarding administrative, renovation or demolition activities.

This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION AND SCOPE

Public Works Government Services Canada (Client) retained Pinchin Ltd. (Pinchin) to conduct a designated substances and hazardous materials survey of select areas of the Canada Centre for Inland Waters, located at 867 Lakeshore Road, Burlington, ON.

The assessment was performed by Leslie Cantar, B. Eng. Mgt, EIT, Project Technologist and Damian Palus, C.E.T., Operations Manager on May 13, 2015. The surveyors were accompanied by Dave Dautovich of Environment Canada during the assessment. The building was occupied at the time of the assessment.

The objective of the assessment was to identify specified designated substances and hazardous materials in preparation for installation of a Centralized Exhaust System to serve levels 4 to 7 of the Administration and Laboratory (A&L) Building. This assessment is intended to be used for pre-construction purposes only, and may not provide sufficient detail for long term management of designated substances and hazardous materials as required by Health and Safety regulations.

1.1 Scope of Assessment

The assessment was performed to establish the location and type of specified hazardous building materials incorporated in the structure and its finishes. The assessed area was limited to the parts of the building within the area to be renovated as described in the revised Statement of Work (SOW) and updated construction drawings. The extent of the assessed area was defined by the Client and Dialog Design.

For the purpose of the assessment and this report, hazardous building materials are defined as follows:

- Asbestos
- Lead
- Silica
- Mercury

The assessment also included:

- Polychlorinated biphenyls (PCBs)
- Ozone depleting substances
- Mould
- Urea formaldehyde foam insulation
- Fuel, oil and/or waste oil storage

- Chemical storage
- Hazardous film or residue within the ducts (Perchloric and Picric Acids)
- Radioactive materials (where signage is present)

The following Ontario Designated Substances are not typically found in building materials in a composition/state that is hazardous and were not included in this assessment:

- Arsenic
- Acrylonitrile
- Benzene
- Coke oven emissions
- Ethylene oxide
- Isocyanates
- Vinyl chloride monomer

2.0 BACKGROUND INFORMATION

Building Description Item	Details
Building Use	Institutional (research and laboratories).
Number of Floors/Levels	8 storeys plus one below grade
Total Area of Building (Square Feet)	300,000
Year of Construction/Significant Additions/Renovations (area assessed)	Approximately 1960 with various additions/renovations up until 2014
Structure	Structural steel, concrete, wood, and concrete block
Exterior Cladding	Pre-cast concrete, metal siding, vinyl siding, brick, and concrete block
HVAC	Boilers and hot water or steam heating to radiators
Roof	Built-up roofing
Flooring	Vinyl tile, vinyl sheet flooring, terrazzo, carpet, concrete, wood and ceramic tile
Interior Walls	Drywall, concrete block, plaster, and brick

Building Description Item	Details
Ceilings	Drywall, acoustic ceiling tiles, and plaster

2.1 Existing Reports

Pinchin previously prepared the following existing reports which were used as reference:

- "Asbestos Assessment of CCIW 867 Lakeshore Road, Burlington", Dated July 12, 2013, Pinchin File: 79576
- "Hazardous Building Materials Assessment of CCIW 867 Lakeshore Road, Burlington", Dated December 19, 2014, Pinchin File: 87784.
- "Designated Substances and Hazardous Materials Survey of CCIW 867 Lakeshore Road, Burlington", Dated March 24, 2015, Pinchin File: 97138.001.

Pinchin was provided and relied on the following existing reports:

- "CCIW Lab Report", Dated October 2011, By District 2 Property Management.
- "Level 2 (Life Cycle) Building Condition Report for Environment Canada Centre for Inland Waters (CCIW) in Burlington, Ontario", Dated September 2009, By PWGSC - RPB - PTP - Maintenance Management Services.
- "CCIW Air Handling Unit Assessment Report", Dated December 2, 2014, By Filer Engineering Ltd.
- "RS 2.2.1 Investigation and Report Central Exhaust System Canada Centre for Inland Waters Labs, AHUs and Heating Upgrade", dated April 24, 2015.
- R.073578.001 Upgrade Project RS 2.2.1 Central Exhaust System Report 2015

3.0 FINDINGS

Where sample numbers are not provided in the findings below with a note stating "previously sampled", it refers to samples collected during the original asbestos assessment, report dated July 12, 2013 or the hazardous building materials assessment, report dated December 19, 2014.

3.1 Asbestos

Refer to Appendix III for the methodology followed to obtain the survey findings.

3.1.1 Suspect Building Materials Not Found

The following types of building materials may historically contain asbestos but were not observed in the building and are not discussed in the report findings:

- Spray-applied fireproofing or thermal insulation
- Texture finishes (acoustic/decorative)
- Firestopping

3.1.2 Thermal Systems Insulation (TSI)

3.1.2.1 Pipe Insulation

Parging cement, containing chrysotile asbestos, is present on pipe fittings (elbows, valves, tees, hangers, etc.) on insulated systems throughout the assessed areas. Parging cement is a friable insulation, jacketed with canvas and is in good condition.

A white preformed block insulation (commonly referred to by the trade names Magnesia Block or Mag Block), containing chrysotile and amosite asbestos, is present in limited locations on straight sections of steam and condensate system pipes. Magnesia block is a friable insulation, jacketed with canvas and in good condition.

Non-asbestos sweatwrap insulation (brown layered paper), is present on straight sections of cold water system pipes, sanitary drains and rain water leaders.

Non-asbestos fibreglass insulation is present on the majority of straight sections of pipe throughout the site. Non-asbestos tar is present on fibreglass pipes throughout the Administration and Laboratory (A&L) building. There was no asbestos parging cement noted on the seams of the insulation at the locations inspected.

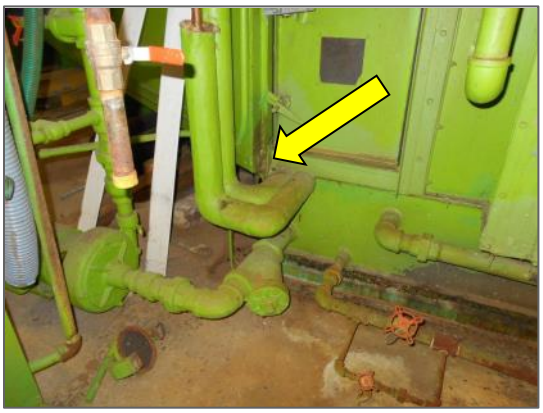
Pipes insulated with friable asbestos insulations may be present in inaccessible spaces such as above solid ceilings, in chases, in column enclosures and within shafts.

Non-asbestos insulations (e.g. fibreglass, armaflex) are present on remaining pipes throughout the assessed areas.

Asbestos-containing pipe insulations are present in the following location, quantity, and condition:

Pipe System, Type	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Parging cement on pipe fittings	Administration and Laboratory (A&L) Third Floor	Previously Sampled	Chrysotile	75 EA	0 EA

Pipe System, Type	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
	Mechanical Room at AHU 27				
Parging cement on pipe fittings	A&L Third Floor Mechanical Room at AHU 28	Previously Sampled	Chrysotile	50 EA	0 EA
Magnesia block on condensate pipe straight	A&L Third Floor Mechanical Room at AHU 27	Previously Sampled	Chrysotile and Amosite	30 LF	0 LF
Parging cement on pipe fittings	A&L Fourth Floor South Service Corridor	Previously Sampled	Chrysotile	4 EA	0 EA
Magnesia block on condensate pipe straight	A&L Fourth Floor South Service Corridor adjacent to Lab L428	Previously Sampled	Chrysotile and Amosite	20 LF	0 LF
Parging cement on pipe fittings	A&L Fifth Floor South Service Corridor	Previously Sampled	Chrysotile	4 EA	0 EA
Magnesia block on condensate pipe straight	A&L Fifth Floor South Service Corridor adjacent to Lab L527	Previously Sampled	Chrysotile and Amosite	30 LF	0 LF
Parging cement on pipe fittings	A&L Sixth Floor South Service Corridor	Previously Sampled	Chrysotile	4 EA	0 EA
Magnesia block on condensate pipe straight	A&L Sixth Floor South Service Corridor adjacent to Lab L625	Previously Sampled	Chrysotile and Amosite	20 LF	0 LF
Parging cement on pipe fittings	A&L Seventh Floor South Service Corridor	Previously Sampled	Chrysotile	4 EA	0 EA
Magnesia block on condensate pipe straight	A&L Seventh Floor South Service Corridor adjacent to Lab L725	Previously Sampled	Chrysotile and Amosite	20 LF	0 LF



Asbestos-containing parging cement on pipe fittings at AHU 27, Third Floor Mechanical Penthouse

Asbestos-containing parging cement on pipe fitting, North end of Sixth Floor South Service Corridor

3.1.2.2 Duct Insulation

Parging cement, containing chrysotile asbestos (sample 0021A), is present over fibreglass insulation at edges, seams and pins on the lower sections of the ductwork serving AHU 27 in the Third Floor Mechanical Room (approximately 1,000 SF). Parging cement is a friable insulation, jacketed with canvas and is in good condition with the exception of five square feet present on the front of the system which is in fair condition.

Remaining ducts are either uninsulated or insulated with non-asbestos fibreglass and jacketed with either canvas or foil.

Asbestos-containing parging cement on fibreglass insulated ductwork, AHU 27, Third Floor Mechanical Room

3.1.2.3 Mechanical Equipment Insulation

Mechanical equipment in the assessed areas is not insulated.

Uninsulated AHU 27, Third Floor Mechanical Penthouse

Uninsulated AHU 28, Third Floor Mechanical Penthouse

3.1.3 Vermiculite

Loose fill vermiculite is not present in the assessed areas. Masonry block walls were inspected at existing openings.

3.1.4 Acoustic Ceiling Tiles

All ceiling tiles present within the assessed areas were determined to be non-asbestos based on the date of manufacture based on the date stamp applied to the top of the tiles (2005). The tiles were manufactured after asbestos stopped being used in acoustic ceiling tiles.

3.1.5 Plaster

Non-asbestos rough plaster is present at duct penetrations through walls in the Service Corridors (samples 0019A-C).

Non-asbestos plaster is present as the second ceiling in Laboratory L533 (previously sampled).

Non-asbestos smooth plaster is present on exterior walls throughout the R&D Ground Floor Wildlife Services and throughout the A&L Fifth Floor Offices (previously sampled).

Non-asbestos rough plaster at duct penetration through wall, Seventh Floor South Service Corridor

Non-asbestos smooth plaster on exterior wall, Office L529, Fifth Floor

3.1.6 Drywall Joint Compound

The majority of drywall finishes present in the assessed areas consisted of panels without joint compound. Drywall joint compound present throughout the assessed areas is non-asbestos (previously sampled and samples 0029A-C).

3.1.7 Asbestos Cement Products (Transite)

Transite board is present in fume hoods and chemical storage cabinets in Laboratory L435, Laboratory L530, Laboratory L629, and Laboratory L632.

Transite pipes are present as exhausts from fume hoods in the Fourth Floor to Seventh Floor South Service Corridor, adjacent laboratories, and the Penthouse Mechanical Room.

Transite is presumed to contain asbestos based on visual observation. Transite is non-friable and in good condition.

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Transite board in fume hoods and chemical storage cabinets	Laboratory L435	Visually Assessed	Chrysotile (assumed)	130 SF	0 SF
Transite board in fume hoods and chemical storage cabinets	Laboratory L530	Visually Assessed	Chrysotile (assumed)	130 SF	0 SF
Transite board in fume hoods and	Laboratory L629	Visually Assessed	Chrysotile (assumed)	130 SF	0 SF

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
chemical storage cabinets					
Transite board in fume hoods and chemical storage cabinets	Laboratory L632	Visually Assessed	Chrysotile (assumed)	130 SF	0 SF
Transite exhaust pipes	Fifth Floor South Service Corridor	Visually Assessed	Chrysotile (assumed)	30 LF	0 LF
Transite exhaust pipes	Laboratory L530	Visually Assessed	Chrysotile (assumed)	70 LF	0 LF
Transite exhaust pipes	Laboratory L533	Presumed above plaster ceiling	Chrysotile (assumed)	50 LF	0 LF
Transite exhaust pipes	Sixth Floor South Service Corridor	Visually Assessed	Chrysotile (assumed)	70 LF	0 LF
Transite exhaust pipes	Laboratory L629	Visually Assessed	Chrysotile (assumed)	10 LF	0 LF
Transite exhaust pipes	Laboratory L632	Visually Assessed	Chrysotile (assumed)	10 LF	0 LF
Transite exhaust pipes	Laboratory L634	Visually Assessed	Chrysotile (assumed)	20 LF	0 LF
Transite exhaust pipes	Seventh Floor South Service Corridor	Visually Assessed	Chrysotile (assumed)	120 LF	0 LF
Transite exhaust pipes	Laboratory L727	Visually Assessed	Chrysotile (assumed)	10 LF	0 LF
Transite exhaust pipes	Penthouse Mechanical Room of the A&L Building	Visually Assessed	Chrysotile (assumed)	250 LF	0 LF

Transite exhaust pipes, Seventh Floor South Service Corridor

Transite board lining fume hood, Laboratory L530

3.1.8 Vinyl Sheet Flooring

Vinyl sheet flooring is present as follows:

Pattern & Colour	Paper Backing (Yes/No)	Locations (Quantity)	Sample Number	Asbestos Type
Beige stone pattern	Yes	Clean Lab L730 (1,000 SF)	Previously Sampled	Chrysotile
Grey speckled pattern	No	Inorganic Chemistry Lab L525, Atomic Absorption Lab L533	Visually Assessed	None

The vinyl sheet flooring is non-friable but can become friable upon removal. Vinyl sheet flooring is in good condition.

The grey vinyl sheet flooring is presumed to be non-asbestos based on historical knowledge of the type of flooring (foam or rubber) and based on the lack of a paper backing layer (underpad).

Asbestos-containing vinyl sheet flooring, beige stone pattern,

Clean Lab L730

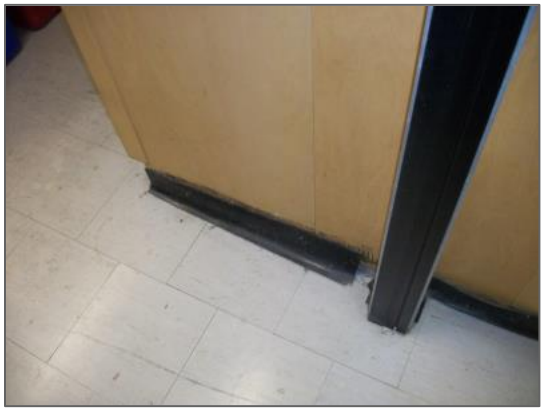
3.1.9 Vinyl Floor Tile and Mastic

Vinyl floor tiles are present as follows:

Size, Pattern, Colour and Photo Number	Locations (Quantity)	Sample Number	Asbestos Type (tile)	Asbestos Type (mastic)
12” x 12” vinyl floor tile, grey with black streaks	Fourth Floor Lab L435 (500 SF), below carpet in A&L Fifth Floor Offices (1,700 SF), R&D Ground Floor WST Calibration Lab (2,500 SF)	Previously Sampled	Chrysotile	None Detected
12” x 12” vinyl floor tile, white with grey specks	Fifth Floor Labs L520 and L522 (1,100 SF), Fifth Floor Labs L527 and L530 (1,100 SF), Sixth Floor Labs L632 and L634 (2,000 SF)	Previously Sampled	Chrysotile	None Detected
12” x 12” vinyl floor tile, white with black flecks	R&D Ground Floor Wildlife Services and Water Survey Copy Room	Previously Sampled and TEM Sample 0035	None Detected	None Detected

The vinyl floor tiles are non-friable and are in good condition.

Asbestos-containing 12” x 12” vinyl floor tiles, grey with black streaks, Lab L435



Asbestos-containing 12” x 12” vinyl floor tiles, white with grey specks, Lab L530

3.1.10 Sealants, Mastics, Caulking, and Putty

Brown mastic, containing chrysotile asbestos, is present on joints of redundant metal exhaust ductwork present above the ceiling tiles in Lab L435 (sample 0020A). Mastic is non-friable and in good condition.

Brown mastic, applied to interior and exterior joints of AHUs 27 and 28, was sampled in the A&L Third Floor Mechanical Room (sample 0023A). Mastic contains chrysotile asbestos, is non-friable, and in good condition.

White caulking, containing chrysotile asbestos, is present at door frames and joints of concrete block walls within the laboratories (previously sampled). Caulking is a non-friable material present in good condition.

Brown putty, containing chrysotile asbestos, is present at the perimeter of glass windows in the fume hoods within Labs L435 and L530 (previously sampled). Putty is a non-friable material present in good condition.

Brown mastic, containing chrysotile asbestos, is present on joints of ductwork within the fan units in Fifth Floor Offices L521 to L532A (sample 0030A). Mastic is non-friable and in good condition.

Non-asbestos grey putty is present at pipe penetrations into AHUs 27 and 28 in the A&L Third Floor Mechanical Room (samples 0022A-C).

Non-asbestos red mastic is present on ducts within the R&D Building (previously sampled).Non-asbestos brown baseboard mastic is present adhering vinyl baseboards throughout Fifth Floor Offices L521 to L532A (samples 0031A-C).

Non-asbestos black caulking is present over non-asbestos clear silicone at exterior penetrations through walls of the A&L Penthouse (samples 0032A-C).

Non-asbestos brown caulking is present at the base of the railings on the Roof of the A&L Building adjacent to the Penthouse (samples 0033A-C).

Non-asbestos black caulking is present at steel beams on the perimeter of the A&L Penthouse adjacent to the Elevator Mechanical Room (samples 0034A-C).

Sealants, mastic, caulking, and putty are non-friable and in good condition.

Remaining sealants, caulking, and putty present in the assessed areas were determined to be non-asbestos based on the nature of the material (silicone or rubber).

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Brown mastic on	Lab L435	0020A	Chrysotile	50 LF	0 LF

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
joints of ductwork					
Brown mastic on joints of AHUs 27 & 28	A&L Third Floor Mechanical Room	0023A	Chrysotile	1,000 LF	0 LF
White caulking at door frames and joints of concrete block	Laboratories	Previously Sampled	Chrysotile	250 LF	0 LF
Brown putty at windows in fume hoods	Labs L435 and L530	Previously Sampled	Chrysotile	120 LF	0 LF
Brown mastic on joints of ductwork within the fan units	Fifth Floor Offices L521 to L532A	0030A	Chrysotile	40 SF	0 LF

Asbestos-containing white caulking at door frame, Laboratory L530

Asbestos-containing brown mastic on redundant metal exhaust duct, Lab L435

Refer to additional photographs in Appendix IV.

3.1.11 Other Building Materials

Bakelite is present as a countertop finish throughout the assessed laboratories from the Fifth to Seventh Floor. Bakelite is a non-friable material that is presumed to contain asbestos based on visual identification. All Bakelite is in good condition.

Built-up roofing, presumed to contain asbestos based on historical knowledge, is present over the building. Asbestos is presumed to be present in the tar layer of roofing, which is a non-friable material and in good condition. Built-up roofing was not sampled during the assessment due to the intrusive nature

of the sampling, and is best sampled prior to renovations where the exact locations of required roofing penetrations are known.

Non-asbestos white undercoating is present on sinks within the laboratories (previously sampled).

Non-asbestos brown baseboard mastic is present within the assessed laboratories (previously sampled).

Vibration dampers within the assessed area were determined to be non-asbestos based on the rubberized nature of the materials.

Material Description	Location	Sample Number	Asbestos Type	Total Quantity	Quantity Damaged
Bakelite	Laboratories	Visually Assessed	Chrysotile (assumed)	800 SF	0 SF
Built-up roofing	Rooftop at Mechanical Penthouse	Not sampled	Chrysotile (assumed)	100 %	0 %

3.1.12 Presumed Asbestos Materials

A number of materials which might contain asbestos were not sampled during our assessment due to limitations in scope and methodology. Where present, these materials must be presumed to be an asbestos material and are best sampled during project planning and preparation of contract documents for their removal. Materials presumed to contain asbestos include:

- roofing, felts and tar
- concrete floor levelling compound
- electrical components or wiring within control centers, breakers, motors or lights, insulation on wiring
- mechanical packing, ropes and gaskets
- fire resistant doors or metal clad finishes

3.2 Lead

3.2.1 Paints and Surface Coatings

A total of two paint samples were collected painted finishes to be affected by the planned work. Nine paint samples were collected within the assessed area during the assessment. The following table summarizes the analytical results for paints sampled and their locations.

Sample Number	Colour, Substrate Description	Locations	Lead (%)
L015	Yellow paint on pipes at AHU 27	A&L Third Floor Mechanical Room	16
L016	Green paint on metal exterior of AHU 27	A&L Third Floor Mechanical Room	14
Previously Sampled	Orange paint on metal fume hood	Throughout Assessed Labs	8.5
Previously Sampled	White paint on concrete block wall	Throughout Assessed Labs	0.050
L022	Off-white paint on drywall walls	R&D Ground Floor Wildlife Services	<0.010
L023	Rose paint on drywall walls	R&D Ground Floor Wildlife Services	0.008
L024	Off-white paint on drywall walls	R&D Ground Floor Water Survey Copy Room	0.006
L025	Off-white paint on plaster walls	A&L Fifth Floor Offices	0.032
L026	Black paint on metal fan units	A&L Fifth Floor Offices	1.7
L027	Black paint on steel beam	A&L Mechanical Penthouse	1.6
L028	Black paint on metal cladding	Exterior of A&L Mechanical Penthouse	0.16

Subject paint was flaking/peeling in the following areas on the following items:

- Green paint on front of AHU 27 in A&L Third Floor Mechanical Room, 15 square feet (SF) flaking and 5 SF debris;
- Green paint on back of AHU 27 in A&L Third Floor Mechanical Room, 10 SF flaking;
- Green paint on front of AHU 28 in A&L Third Floor Mechanical Room, 10 SF flaking;
- Green paint on back of AHU 28 in A&L Third Floor Mechanical Room, 10 SF flaking; and
- Green paint on AHU 28 below ductwork on north end, A&L Third Floor Mechanical Room, 15 SF flaking.

Flaking lead-containing green paint on AHU 27, Third Floor Mechanical Room

Flaking lead-containing green paint below ductwork on AHU 28, Third Floor Mechanical Room

Appendix II-B presents the lead bulk sample analytical results.

3.2.2 Lead Products and Applications

Lead-containing products were not found within the assessed areas.

3.2.3 Presumed Lead Materials

Lead may be present in a number of materials which were not assessed and/or sampled. The following materials, where found, should be considered to contain lead.

- electrical components, including wiring connectors, fibre optic cable sheathing, grounding conductors, and solder

3.3 Silica

Crystalline silica is a presumed component of the following building materials where present in the building:

- poured or pre-cast concrete
- masonry and mortar
- plaster

3.4 Mercury

3.4.1 Lamps

Mercury vapour is present in fluorescent lamps where present in the assessed area.

3.4.2 Mercury-Containing Devices

Mercury-containing devices were not found during the survey.

3.5 Polychlorinated Biphenyls

3.5.1 Caulking

Suspect exterior caulking which would be affected by the renovations was not present.

3.5.2 Lighting Ballasts

Based on information from the Client and confirmed by visual observations (evidence of T-8 fixtures) the building has been comprehensively re-lamped and will not contain PCB ballasts.

3.5.3 Transformers

All transformers in the site are dry type transformers and do not contain PCB-containing dielectric fluids.

3.6 Ozone Depleting Substances

Ozone depleting substances were not found within the assessed areas.

3.7 Mould

Visible mould growth was not found in the assessed areas.

3.8 Hazardous Chemicals

The following chemicals were listed as having been used in the labs included in the assessed area, as per the CCIW Lab Report provided by Environment Canada:

Laboratory	Predominant Chemicals
Lab L520 – Ontario Fresh Water Quality Monitoring Lab	Acetone, petroleum ether, dichloromethane
Lab L525 – Lake Management Research Lab	None
Lab L527 – Organic Sediments Lab	Standard mixtures of greenhouse gases (CO2, N2O, CH4, CO) in nitrogen, phosphoric acid, pure copper and tin in scrubbers, platinum in catalysts
Lab L530 – Geochemistry Lab	Sulfuric acid, methanol, ethanol

Laboratory	Predominant Chemicals
Lab L533 – Trace Metals Clean Lab	Nitric acid, hydrochloric acid, acetic acid, sulfuric acid, potassium bromate, bromide, sodium acetate, sodium hydroxide
Labs L629 – Groundwater Assessment Remediation Preparation Lab	Nitric acid, ammonium, reagents
Lab L632 – Lake Management Research Sediment Lab	Hydrochloric acid, sulfuric acid, acetone, dichloromethane, alcohol
Lab L634 – Wildlife Toxicology Research Storage & Field Preparation Lab	Hexane, acetone, ethanol, Bouin's solution, pesticides, aqueous ammonia, sodium heparin, liquid/gaseous nitrogen
Lab L730 – Trace Organic Contaminant (Clean Room)	Dichloromethane, methanol, hexane, iso-octane, acetone. Solids include: silica gel, sodium sulphate, sodium hydroxide, Hydromatrix, XAD-2, Polymer resin, and copper granules.

Other chemicals may be present in minor quantities and are not expected to be present as residue in ductwork.

3.9 Other Hazardous Materials

Other hazardous materials including urea formaldehyde foam insulation, fuel or waste oil, hazardous duct residue (perchloric or picric acid), and radioactive materials were not observed during the assessment.

4.0 RECOMMENDATIONS

4.1 General

1. Prepare plans and specifications for hazardous material removal which will or may be affected by the planned work or is otherwise scheduled for removal. The specifications should include and address the scope of work, safe work practices, personal protective equipment, respiratory protection, and disposal of waste materials.
2. Investigate any items excluded from the scope of work of this report. Ideally this investigation will be performed immediately prior to commencing renovations. Specifically the following materials/areas need to be investigated:

- Presumed asbestos-containing built-up roofing in areas where penetrations or removal will be required.

3. Provide this report and the detailed plans and specifications to the contractor prior to bidding or commencing work.
4. Retain a qualified consultant to specify, inspect and verify the successful removal of hazardous materials.
5. Update the asbestos inventory upon completion of the abatement and removal of asbestos-containing materials.

4.2 Remedial Work

We recommend the following remedial work be performed to comply with existing regulations, regardless of proposed construction work due to the condition and location of the material:

Material and Quantity	Location	Recommended Procedure
Parging cement on insulated duct serving AHU 27, 5 SF	Third Floor Mechanical Room	Repair following Type 2 asbestos procedures as per Ontario Regulation 278/05
Green paint on front of AHU 27, 10 SF flaking and 5 SF debris	Third Floor Mechanical Room	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document
Green paint on back of AHU 27, 10 SF flaking;	Third Floor Mechanical Room	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document
Green paint on front of AHU 28, 10 SF flaking	Third Floor Mechanical Room	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document
Green paint on back of AHU 28, 10 SF flaking	Third Floor Mechanical Room	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document
Green paint on AHU 28 below ductwork on north end,15 SF flaking	Third Floor Mechanical Room	Removal and clean-up following Type 2a lead procedures as per Lead on Construction Projects, Ministry of Labour Guidance Document

The cost estimate to complete all remedial work as outlined in the above table is $1,000.00, plus applicable taxes.

4.3 Building Demolition or Renovation Work

The following recommendations are made regarding demolition or renovation involving the designated substances and hazardous materials identified; refer to sections below for additional information for Designated Substance and Hazardous Material abatement.

Designated Substance/ Hazardous Material	Material(s)	Recommended Regulation/ Guideline to be Followed
Asbestos	• Pipe insulation • Duct insulation • Drywall joint compound • Transite • Vinyl floor tiles • Vinyl sheet flooring • Mastics • Caulking • Bakelite • Putty • Built-up roofing	Ontario Regulation 278/05
Lead	• Paint	Ministry of Labour Guideline – Lead on Construction Projects, 2004
Silica	• Concrete, mortar, masonry and ceramics	Ministry of Labour Guideline – Silica on Construction Projects, 2004
Mercury	• Fluorescent lamps	R.R.O. 1990, Regulation 844, Amended to O.Reg. 110/04, Designated Substance — Mercury
Stored Chemicals	• Acetone, petroleum ether, dichloromethane • Greenhouse gases (CO2, N2O, CH4, CO) in nitrogen, phosphoric acid, pure copper and tin in scrubbers, platinum in catalysts • Sulfuric acid, methanol, ethanol • Nitric acid, hydrochloric acid, acetic acid, sulfuric acid, potassium bromate, bromide, sodium acetate, sodium hydroxide • Ammonium, reagents	Follow appropriate handling and removal procedures as per the Material Safety Data Sheets

Designated Substance/ Hazardous Material	Material(s)	Recommended Regulation/ Guideline to be Followed
	• Alcohol • Hexane, Bouin's solution, pesticides, aqueous ammonia, sodium heparin, liquid/gaseous nitrogen • Iso-octane. Solids include: silica gel, sodium sulphate, sodium hydroxide, Hydromatrix, XAD-2, Polymer resin, and copper granules.	

4.3.1 Asbestos

Remove all asbestos-containing materials (ACM) prior to renovation, alteration, maintenance or demolition work or if ACM may be disturbed by the work.

If the identified ACM will not be removed prior to commencement of the work, disturbance of ACM must follow the appropriate asbestos precautions for the classification of work being performed.

Asbestos-containing materials must be disposed of at a landfill approved to accept asbestos waste.

4.3.1.1 Pipe Insulation

If pipe insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing pipe insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of pipe insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05. Alternately use Glove Bag Procedures as outlined within Ontario Regulation 278/05.

If jacketing over asbestos insulation is to be repaired (e.g. canvas and lagging), use Type 2 procedures as outlined within Ontario Regulation 278/05.

4.3.1.2 Duct Insulation

If parging cement on duct insulation is to be removed, remove minor amounts (less than 1 square metre) of asbestos-containing insulations using Type 2 procedures as outlined within Ontario Regulation 278/05. If larger amounts of duct insulation (greater than 1 square metre) are to be removed, use Type 3 procedures as outlined within Ontario Regulation 278/05.

If jacketing over asbestos parging cement insulation is to be repaired (e.g. canvas and lagging), use Type 2 procedures as outlined within Ontario Regulation 278/05.

If paper on duct insulation is to be removed, remove using Type 2 asbestos procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.3 Asbestos-Cement (Transite) Materials

If asbestos cement (Transite) materials must be removed as a result of planned demolition, renovation, etc. use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.4 Vinyl Floor Tiles

If vinyl floor tiles must be removed as a result of planned demolition, renovation, etc., use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.5 Vinyl Sheet Flooring

Vinyl sheet flooring is a non-friable material that can become friable, and can generate significant dust, upon removal. Therefore, if vinyl sheet flooring is to be abated as a result of planned demolition, renovation, etc., use Type 2 abatement procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.6 Sealants, Mastic, Caulking, and Putty

If the caulking must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.7 Bakelite

If the Bakelite must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.1.8 Built-up Roofing

If the built-up roofing must be removed as a result of planned demolition, renovation, etc, use Type 1 procedures as outlined within Ontario Regulation 278/05 if the work is done using wet methods and using hand-held non-powered tools.

4.3.2 Lead

Construction disturbance of lead in paint and coatings (or other materials) may result in over-exposure to lead dust or fumes. The need for work procedures, engineering controls and personal protective equipment will need to be assessed on a project-by-project basis and must comply with provincial standards or guidelines. Performing an exposure assessment during work that disturbs lead in paints and coatings may be able to alleviate the use of some of the precautions specified by these standards or guidelines.

Type 1 Lead Operations

- Removal of lead-containing coatings with a chemical gel or paste and fibrous laminated cloth wrap.
- Removal of lead-containing coatings or materials using a power tool that has an effective dust collection system equipped with a HEPA filter.
- Removal of lead-containing sheet metal.
- Removal of lead-containing packing, babbit or similar material.
- Removal of lead-containing coatings or materials using non-powered hand tools, other than manual scraping or sanding.
- Soldering.

Type 2A Lead Operations

- Welding or high temperature cutting of lead-containing coatings or materials outdoors. This operation is considered a Type 2A operation only if it is short-term, not repeated, and if the material has been stripped prior to welding or high temperature cutting. Otherwise, it will be considered a Type 3A operation.
- Removal of lead-containing coatings or materials by scraping or sanding using non-powered hand tools.
- Manual demolition of lead-painted plaster walls or building components by striking a wall with a sledgehammer or similar tool.

Type 3A Lead Operations

- Welding or high temperature cutting of lead-containing coatings or materials indoors or in a confined space.
- Burning of a surface containing lead.

- Dry removal of lead-containing mortar using an electric or pneumatic cutting device.
- Removal of lead-containing coatings or materials using power tools without an effective dust collection system equipped with a HEPA filter.
- Removal or repair of a ventilation system used for controlling lead exposure.
- An operation that may expose a worker to lead dust, fume or mist that is not a Type 1, Type 2, or Type 3B operation.

Type 3B Lead Operations

Abrasive blasting of lead-containing coatings or materials.

Lead-painted items may be a hazardous waste. Test lead-painted materials for leachable lead prior to disposal.

Lead-containing items (e.g. lead-acid batteries) should be recycled when taken out of service or prior to building demolition.

4.3.3 Silica

Construction disturbance of silica-containing products may result in excessive exposures to airborne silica, especially if performed indoors and dry. Cutting, grinding, drilling or demolition of materials containing silica should be completed only with proper respiratory protection and other worker safety precautions that comply with provincial standards or guidelines.

Type 1 Silica Operations

- The drilling of holes in concrete or rock that is not part of a tunnelling operation or road construction.
- Milling of asphalt from concrete highway pavement.
- Charging mixers and hoppers with silica sand (sand consisting of at least 95 per cent silica) or silica flour (finely ground sand consisting of at least 95 percent silica).
- Any other operation at a project that requires the handling of silica-containing material in a way that may result in a worker being exposed to airborne silica.
- Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling.
- Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.

Type 2 Silica Operations

- Removal of silica containing refractory materials with a jackhammer.
- The drilling of holes in concrete or rock that is part of a tunnelling or road construction.
- The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials.
- The use of a power tool to remove silica containing materials.
- Tunnelling (operation of the tunnel boring machine, tunnel drilling, tunnel mesh installation).
- Tuckpoint and surface grinding.
- Dry mortar removal with an electric or pneumatic cutting device.
- Dry method dust cleanup from abrasive blasting operations.
- The use of compress air outdoors for removing silica dust.
- Entry into area where abrasive blasting is being carried out for more than 15 minutes.

Type 3 Silica Operations

- Abrasive blasting with an abrasive that contains ≥ 1 percent silica.
- Abrasive blasting of a material that contains ≥ 1 percent silica.

4.3.4 Mercury

Do not break lamps. Recycle and reclaim mercury from fluorescent light tubes when taken out of service. Light tubes are accepted free of charge at many local recycling depots.

4.3.5 Mould

No mould was observed. If mould is uncovered inside wall cavities during hand demolition, use appropriate precautions and protect workers using methods that comply with provincial guidelines.

4.3.6 Stored Chemicals:

Use appropriate precautions and protect workers using methods that comply with the Material Safety Data Sheets for stored chemicals.

5.0 LIMITATIONS

The work performed by Pinchin was conducted in accordance with generally accepted engineering or scientific practices current in this geographical area at the time the work was performed. No warranty is either expressed or implied by furnishing written reports or findings. The Client acknowledges that subsurface and concealed conditions may vary from those encountered or inspected. Pinchin can only comment on the environmental conditions observed on the date(s) the survey is performed. The work is limited to those materials or areas of concern identified by the Client or outlined in our proposal. Other areas of concern may exist but were not investigated within the scope of this assignment.

Pinchin makes no other representations whatsoever, including those concerning the legal significance of its findings or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issue, regulatory statutes are subject to interpretation and these interpretations may change over time. Pinchin accepts no responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The liability of Pinchin or our officers, directors, shareholders or staff will be limited to the lesser of the fees paid or actual damages incurred by the Client. Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered (Claim Period), to commence legal proceedings against Pinchin to recover such losses or damage unless the laws of the jurisdiction which governs the Claim Period which is applicable to such claim provides that the applicable Claim Period is greater than two years and cannot be abridged by the contract between the Client and Pinchin, in which case the Claim Period shall be deemed to be extended by the shortest additional period which results in this provision being legally enforceable.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

6.0 REFERENCES

The following legislation and documents were referenced in completing the assessment and this report:

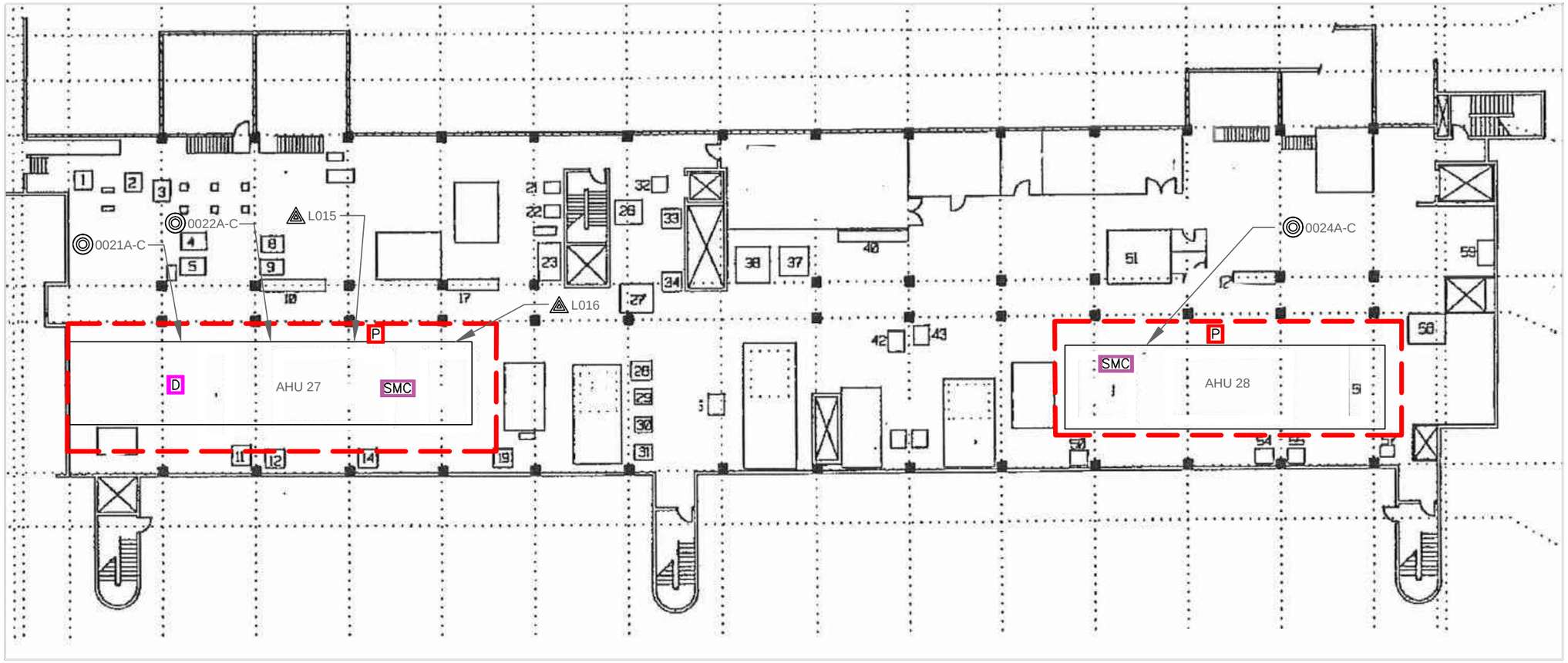
1. Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05.
2. Designated Substances, Ontario Regulation 490/09.
3. Lead on Construction Projects, Ministry of Labour Guidance Document.
4. Ministry of the Environment Regulation, R.R.O. 1990 Reg. 347 as amended.
5. Surface Coating Materials Regulations, SOR/2005-109, Hazardous Products Act.
6. Silica on Construction Projects, Ministry of Labour Guidance Document.
7. Alert – Mould in Workplace Buildings, Ontario Ministry of Labour.

J:\97000s\97138 PWGSC,867Lakeshore,Burl,DSUB,ASSMT\97138.001 PWGSC,867Lakeshore,Burl,DSUB,ASSMT\Report\97138.001 PWGSC 867 Lakeshore Rd Burlington Additional Scope HazMat Report July 15 2015 FINAL.docx

Template: Master Report for Hazardous Materials Assessment Report (Pre-Construction), Haz, December 10, 2014

APPENDIX I

Drawings



LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

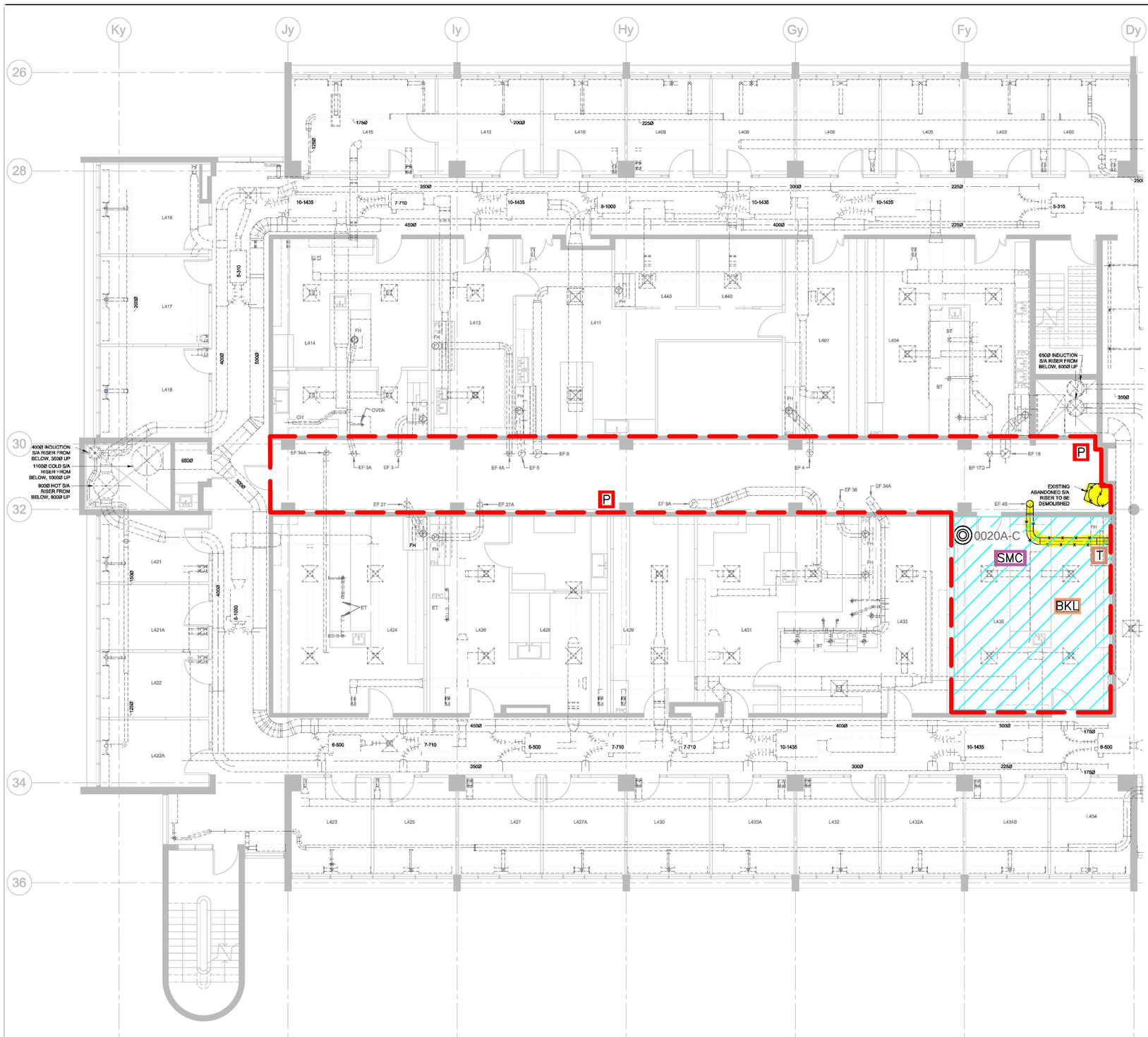
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
THIRD FLOOR

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING:
CHECKED BY: LNC	1 OF 9
SCALE: NTS	



1 M1.10 4TH FLOOR EXHAUST UPGRADE DEMOLITION PLAN
SCALE: 1:50

PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

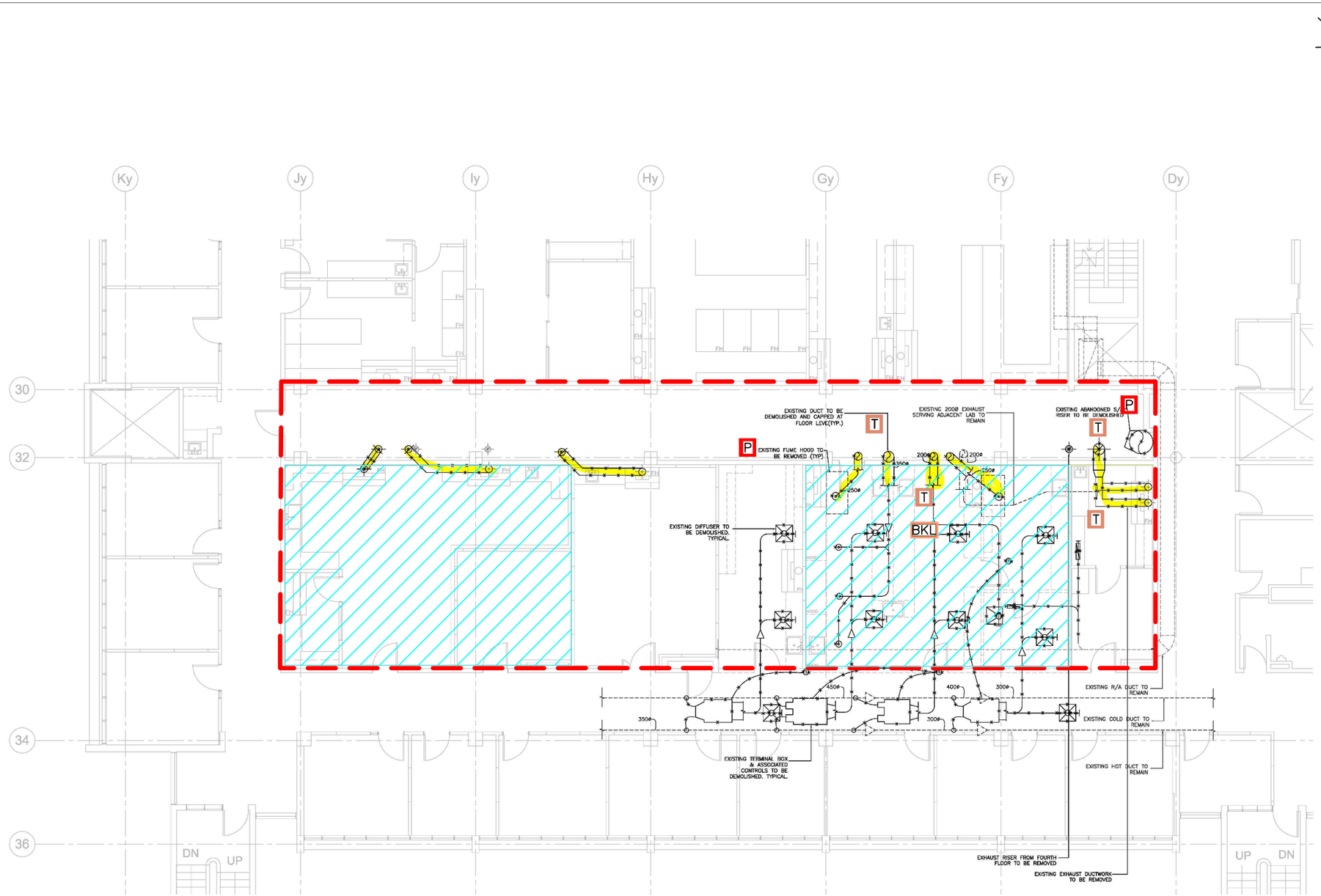
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
FOURTH FLOOR

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING:
CHECKED BY: LNC	2 OF 9
SCALE: NTS	



1 M1.12 5TH FLOOR L527/530 HVAC DEMOLITION PLAN
SCALE: 1:50

DEMOLITION GENERAL NOTES

1. DEMOLISH EXISTING DIFFUSERS, GRILLES, DUCTWORK, DUCT FITTINGS, CONTROLS, TERMINAL BOXES AS SHOWN.
2. CONTRACTOR IS TO REVIEW THE SITE DUCT ROUTING AND SITE CONDITION AND IDENTIFY AREAS OF POTENTIAL INTERFERENCE. CONTRACTOR IS TO PROVIDE CLEARLY LABELED SKETCHES TO ENGINEER THAT IDENTIFIES INTERFERENCES WITH NEW WORK. SUBMIT PRIOR TO ANY NEW CONSTRUCTION.
3. REMOVE ALL DEBRIS AND RUBBISH AT EVERY SCHEDULED CLEAN UP.
4. ALL DEMOLISHED BRANCH DUCTWORK SHALL BE CUT-BACK AND CAPPED AT MAIN AIRTIGHT.
5. COORDINATE SHUTDOWN OF SERVICES WITH THE OWNER PRIOR TO COMMENCING WORK.

PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
FIFTH FLOOR

DATE:	PROJECT # :
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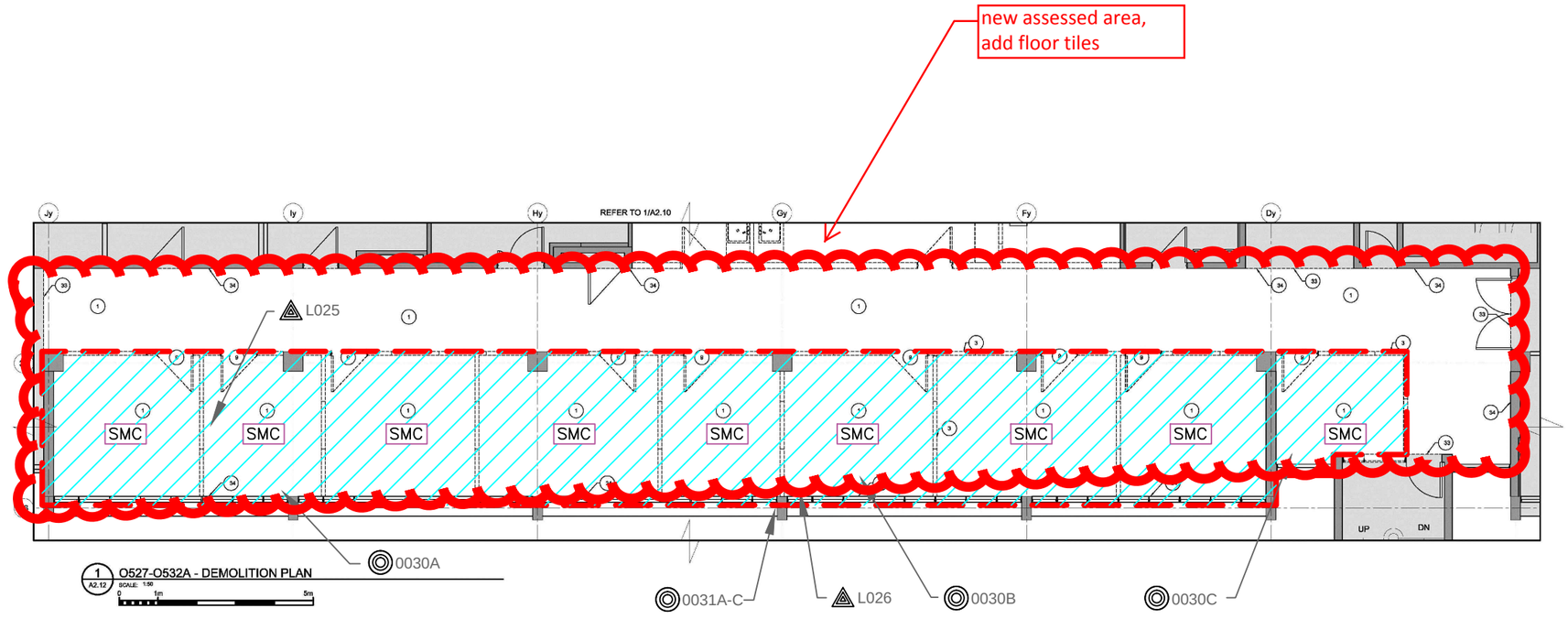
DRAWN BY: KGB	DRAWING: 3 OF 9
CHECKED BY: LNC	
SCALE: NTS	



PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

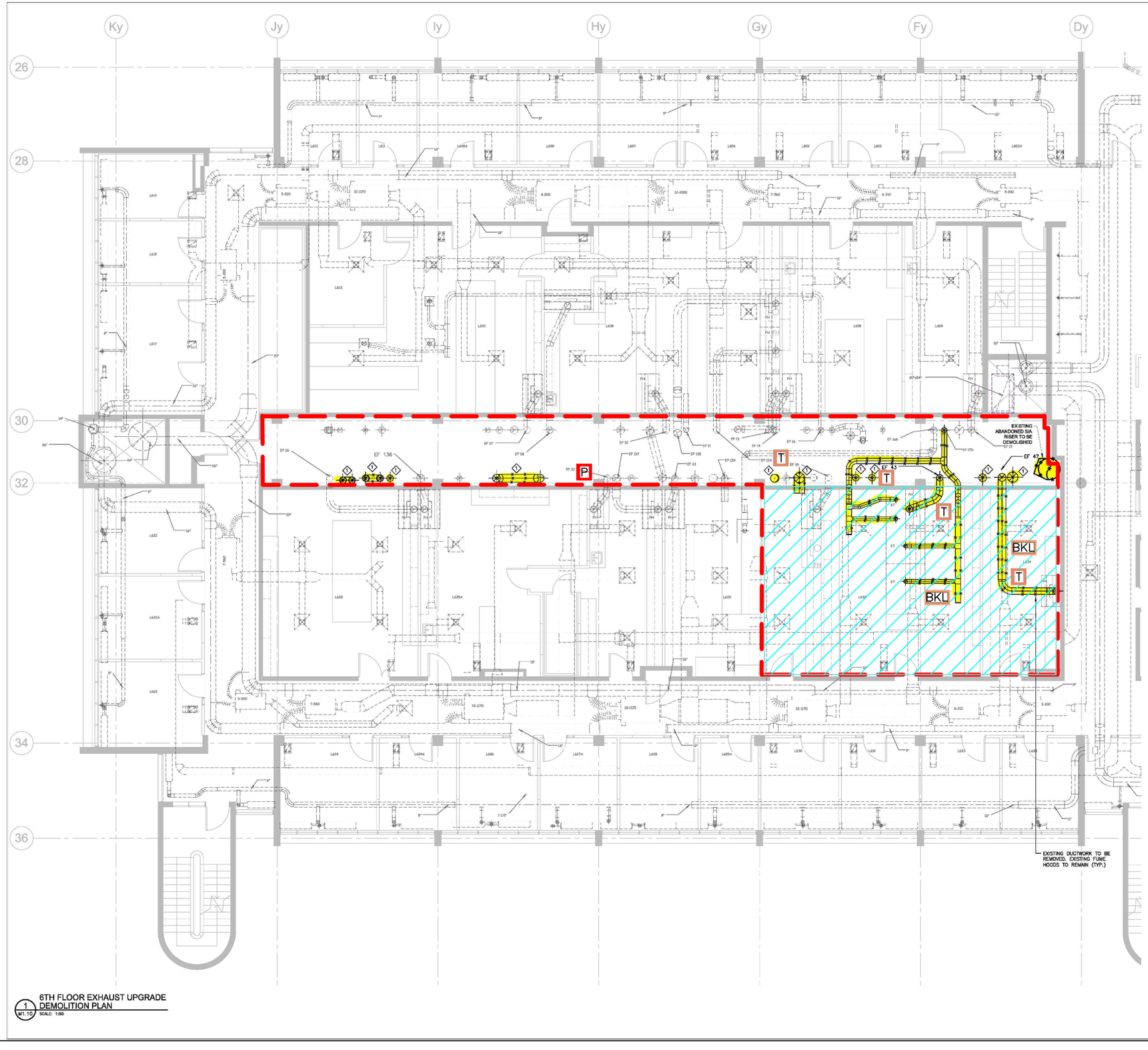
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
FIFTH FLOOR OFFICE RENOVATION

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING:
CHECKED BY: LNC	4 OF 9
SCALE: NTS	



1 M1.10 6TH FLOOR EXHAUST UPGRADE DEMOLITION PLAN
SCALE: 1:50

KEYNOTES

1 EXHAUST DUCT RISER FROM FLOOR BELOW TO BE REMOVED.

PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

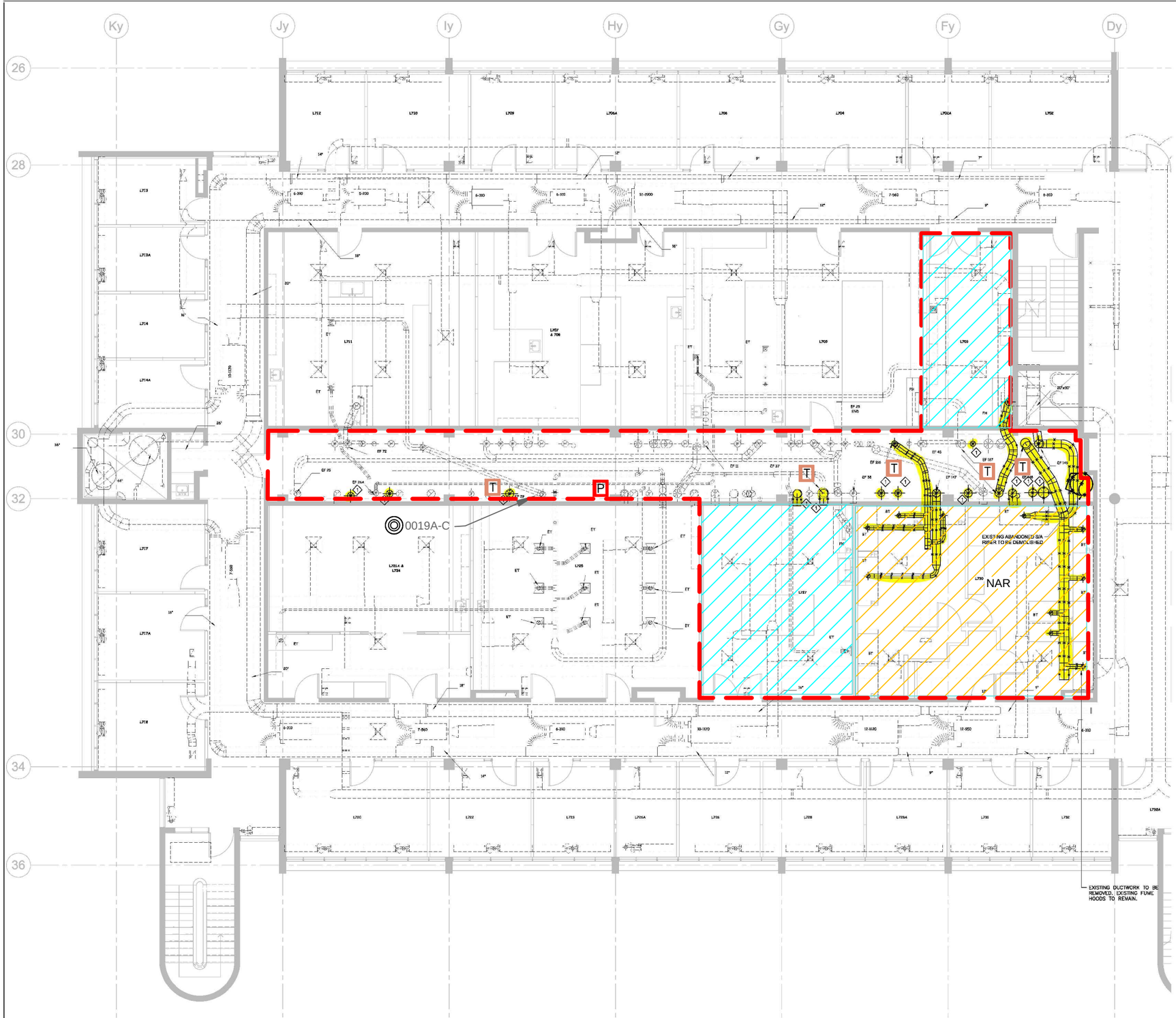
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
SIXTH FLOOR

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING: 5 OF 9
CHECKED BY: LNC	
SCALE: NTS	



1 U1.14 7TH FLOOR EXHAUST UPGRADE DEMOLITION PLAN
SCALE: 1:50

KEYNOTES
1 EXHAUST DUCT RISER FROM FLOOR BELOW TO BE REMOVED.

PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

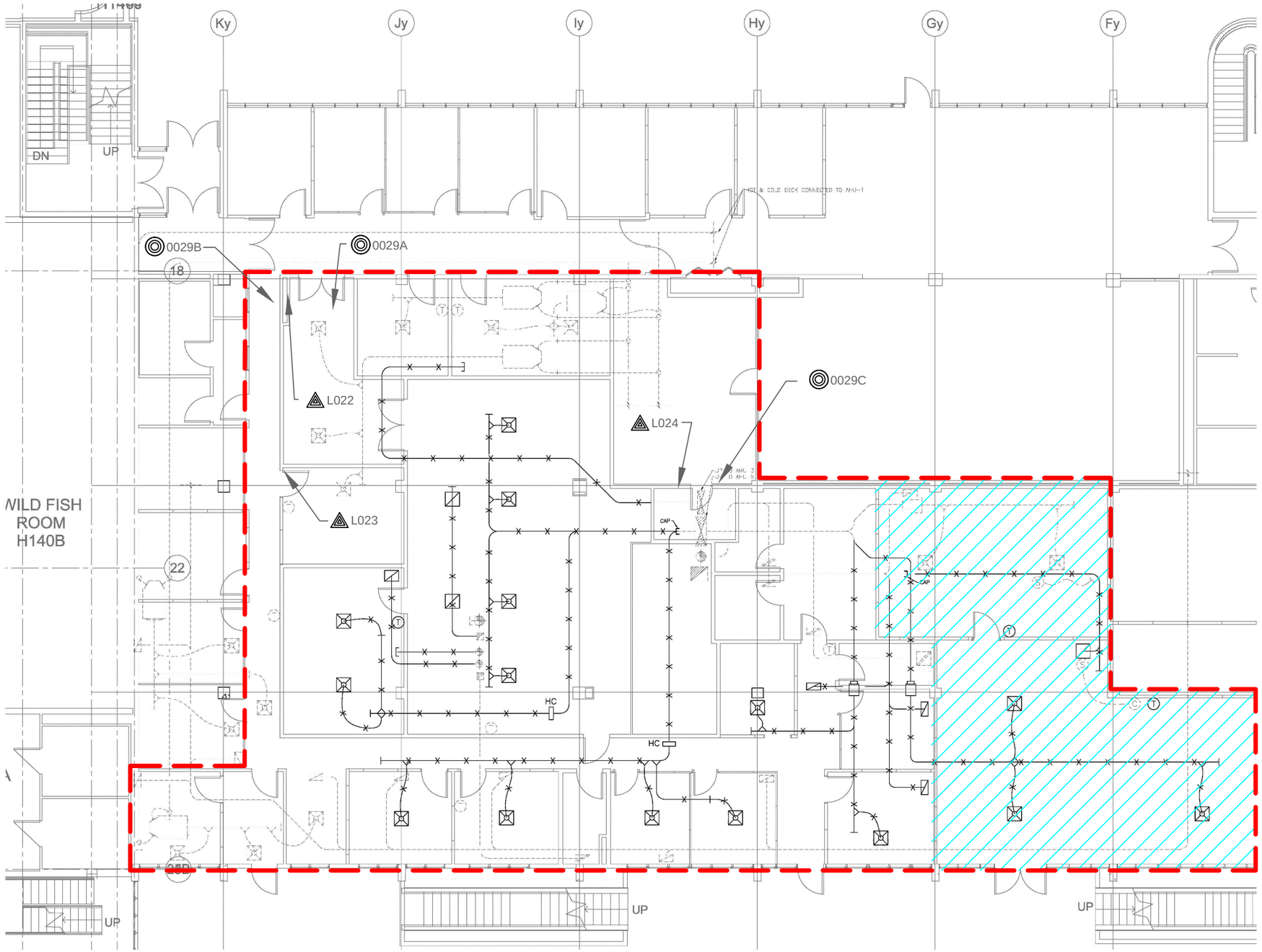
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
SEVENTH FLOOR

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING: 6 OF 9
CHECKED BY: LNC	
SCALE: NTS	



GROUND FLOOR
HVAC DEMOLITION PLAN
1 / M1.20 SCALE: 1:50

GENERAL NOTES

1. CONTRACTOR TO COORDINATE ANY SHUTDOWN OF EQUIPMENT WITH OWNER PRIOR TO COMMENCING WORK.
2. EXISTING DUCTWORK, GRILLES, DIFFUSERS AND CONTROLS TO BE DEMOLISHED AND REMOVED AS INDICATED.
3. DISCONNECT AND CAP HOT WATER SUPPLY AND RETURN PIPING FROM HOT WATER REHEAT COILS AND PREP FOR RECONNECTION TO NEW EQUIPMENT.

PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

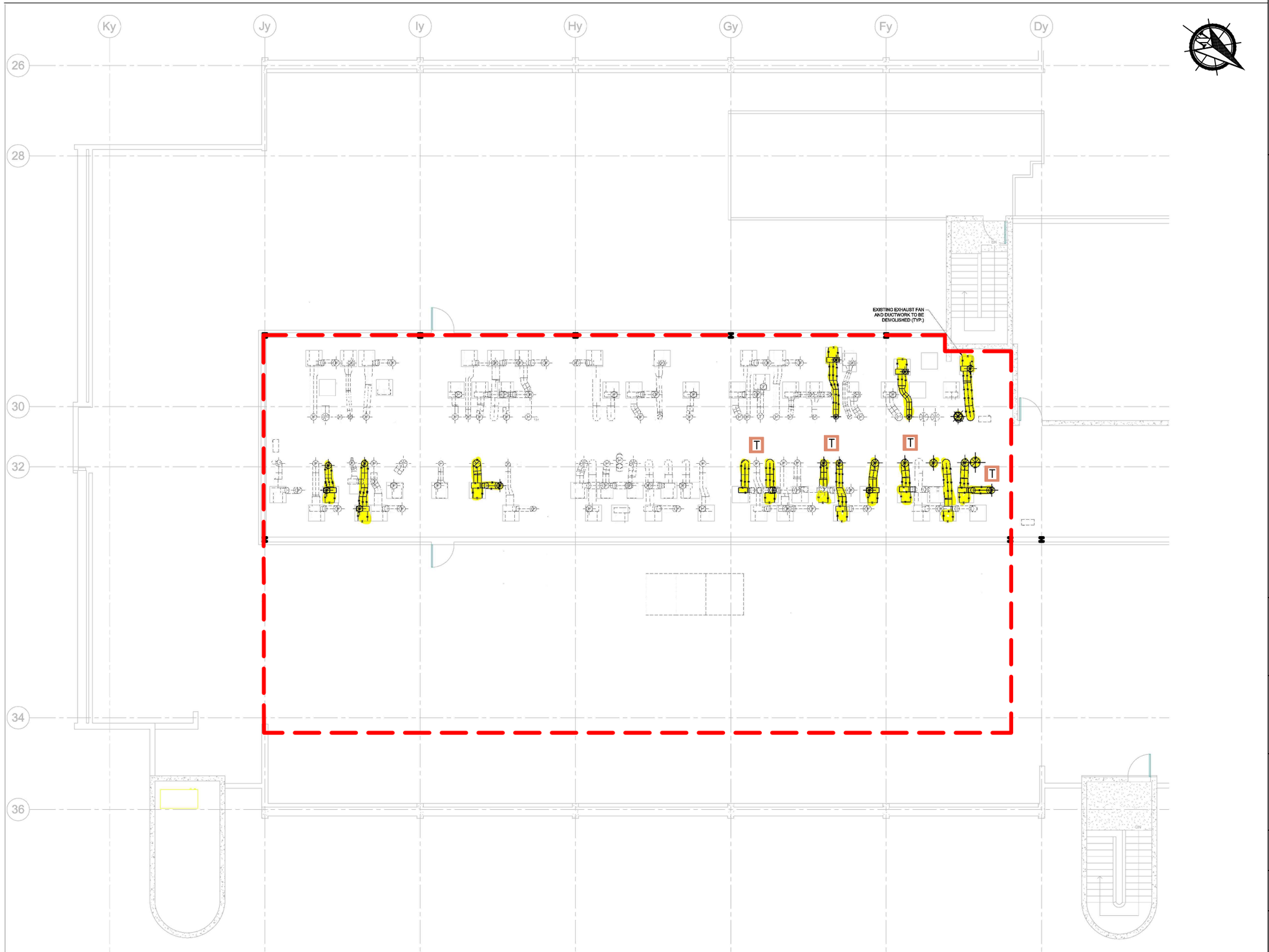
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
GROUND FLOOR RENOVATION AREA

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING: 7 OF 9
CHECKED BY: LNC	
SCALE: NTS	



PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

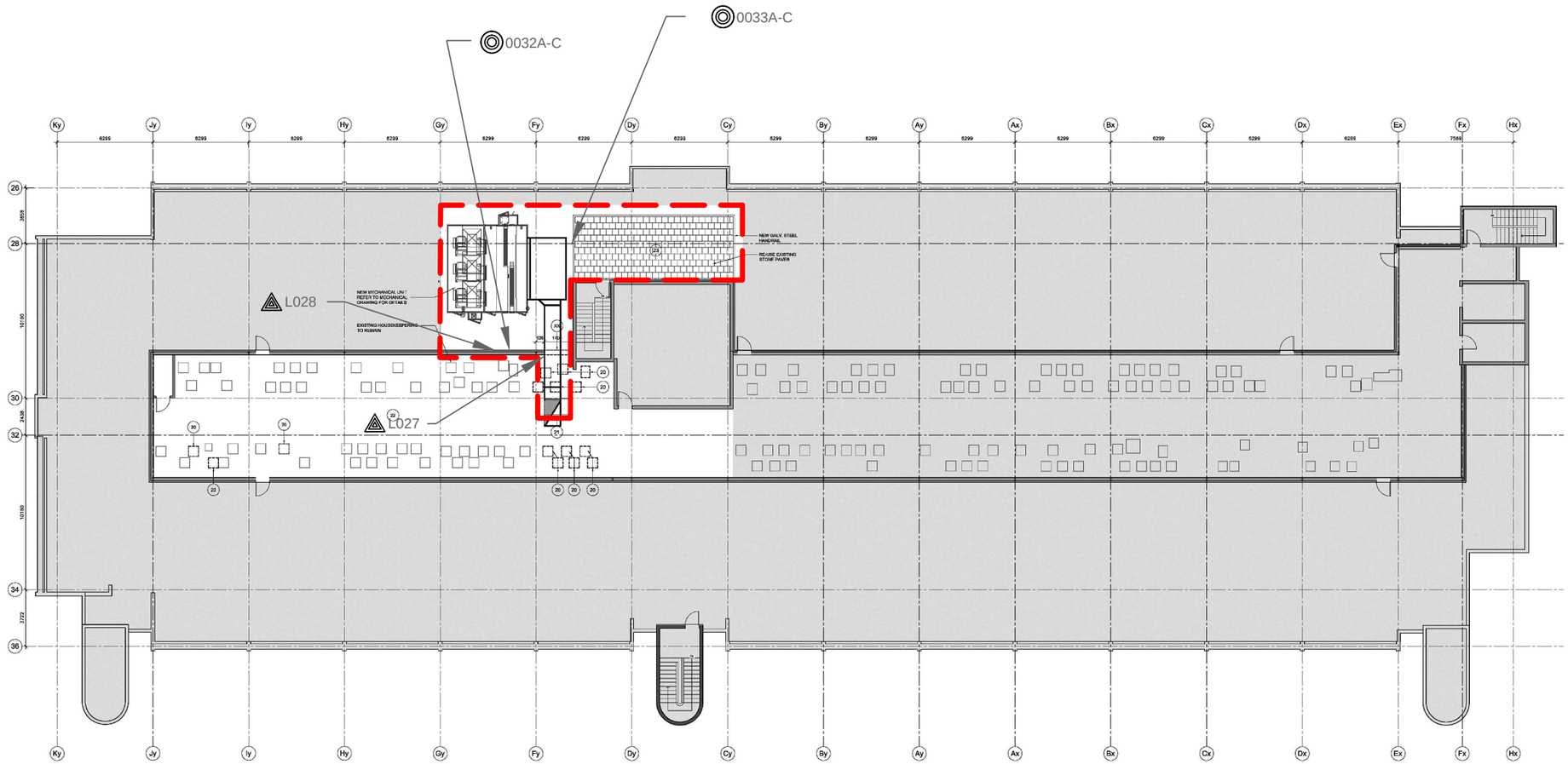
NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
PENTHOUSE / ROOF

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING: 8 OF 9
CHECKED BY: LNC	
SCALE: NTS	



1 A&L BUILDING ROOF LOCATION PLAN
A1.16 SCALE: 1:100

PINCHIN

LEGEND:

- SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- NAR NO ACCESS TO ROOM/AREA

ASBESTOS-CONTAINING MATERIALS:

- D A-C DUCT INSULATION
- P A-C PIPE INSULATION
- SMC A-C SEALANTS, MASTICS, OR CAULKING
- A-C VINYL FLOOR TILES
- A-C VINYL SHEET FLOORING
- BKL BAKELITE
- T TRANSITE

NOTE: LEAD-CONTAINING PAINTS, SILICA-CONTAINING BUILDING MATERIALS AND MERCURY FLUORESCENT LAMPS ARE PRESENT THROUGHOUT.

CLIENT:
PUBLIC WORKS GOVERNMENT SERVICES CANADA

LOCATION:
867 LAKESHORE ROAD
BURLINGTON, ONTARIO, L7R 4A6

TITLE:
DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
ROOF LOCATION PLAN

DATE:	PROJECT # :
JULY 2015	97138.001
DRAWN BY: KGB	DRAWING: 9 OF 9
CHECKED BY: LNC	
SCALE: NTS	

APPENDIX II-A

Asbestos Analytical Certificates

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0019A *1509550PLM_1*	Rough plaster on wall at duct penetrations, South Service Corridor, 7th Floor *single layer*	**None Detected**		**80% Other** **20% Perlite**	Gray Non Fibrous Heterogeneous Crushed
0019B *1509550PLM_2*	Rough plaster on wall at duct penetrations, South Service Corridor, 7th Floor *single layer*	**None Detected**		**80% Other** **20% Perlite**	Gray Non Fibrous Heterogeneous Crushed
0019C *1509550PLM_3*	Rough plaster on wall at duct penetrations, South Service Corridor, 7th Floor *single layer*	**None Detected**		**80% Other** **20% Perlite**	Gray Non Fibrous Heterogeneous Crushed
0020A *1509550PLM_4*	Brown mastic on joints of redundant metal exhaust duct, Lab L435	**2% Chrysotile**		**98% Other**	Brown Non Fibrous Homogeneous Ashed
0020B *1509550PLM_5*	Brown mastic on joints of redundant metal exhaust duct, Lab L435	**Not Analyzed**			
0020C *1509550PLM_6*	Brown mastic on joints of redundant metal exhaust duct, Lab L435	**Not Analyzed**			
0021A *1509550PLM_7*	Parging cement on square ductwork, AHU 27, Third Floor Mechanical Room	**30% Chrysotile**		**70% Other**	White Fibrous Homogeneous Teased
0021B *1509550PLM_8*	Parging cement on square ductwork, AHU 27, Third Floor Mechanical Room	**Not Analyzed**			

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Sharon Donald (30)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0021C *1509550PLM_9*	Parging cement on square ductwork, AHU 27, Third Floor Mechanical Room	**Not Analyzed**			
0022A *1509550PLM_10*	Putty at pipe penetrations into AHU 27, Third Floor Mechanical Room	**None Detected**	**5% Cellulose**	**95% Other**	Gray Non Fibrous Homogeneous Dissolved
0022B *1509550PLM_11*	Putty at pipe penetrations into AHU 27, Third Floor Mechanical Room	**None Detected**	**5% Cellulose**	**95% Other**	Gray Non Fibrous Homogeneous Dissolved
0022C *1509550PLM_12*	Putty at pipe penetrations into AHU 27, Third Floor Mechanical Room	**None Detected**	**5% Cellulose**	**95% Other**	Gray Non Fibrous Homogeneous Dissolved
0023A *1509550PLM_13*	Brown caulking at seams of AHU 28, Third Floor Mechanical Room	**1% Chrysotile**		**99% Other**	Brown, Green Non Fibrous Heterogeneous Dissolved
0023B *1509550PLM_14*	Brown caulking at seams of AHU 28, Third Floor Mechanical Room	**Not Analyzed**			
0023C *1509550PLM_15*	Brown caulking at seams of AHU 28, Third Floor Mechanical Room	**Not Analyzed**			
0024A *1509550PLM_16*	Brown caulking at joints of exhaust for AHU 5, Third Floor R&D Mechanical Penth	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Sharon Donald (30)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0024B *1509550PLM_17*	Brown caulking at joints of exhaust for AHU 5, Third Floor R&D Mechanical Penth	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0024C *1509550PLM_18*	Brown caulking at joints of exhaust for AHU 5, Third Floor R&D Mechanical Penth	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0025A *1509550PLM_19*	Black tar at gas pipe penetration, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0025B *1509550PLM_20*	Black tar at gas pipe penetration, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0025C *1509550PLM_21*	Black tar at gas pipe penetration, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0026A *1509550PLM_22*	Black mastic at corners of duct seams, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0026B *1509550PLM_23*	Black mastic at corners of duct seams, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0026C *1509550PLM_24*	Black mastic at corners of duct seams, Roof of Hydraulics at AHU 44	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed

Sharon Donald (30)

Analyst

Approved Signatory

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509550
Analysis ID: 1509550_PLM
Date Received: 5/18/2015
Date Reported: 5/27/2015

Project: Public Works Government Services Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID / *Lab Sample ID*	Description / *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes / Treatment
0027A / *1509550PLM_25*	Grey caulking at electrical wiring penetration, Roof of Hydraulics at AHU 44 exhaust	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0027B / *1509550PLM_26*	Grey caulking at electrical wiring penetration, Roof of Hydraulics at AHU 44 exhaust	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0027C / *1509550PLM_27*	Grey caulking at electrical wiring penetration, Roof of Hydraulics at AHU 44 exhaust	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0028A / *1509550PLM_28*	Grey caulking on exterior joints of AHU 44, Roof of Hydraulics	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0028B / *1509550PLM_29*	Grey caulking on exterior joints of AHU 44, Roof of Hydraulics	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed
0028C / *1509550PLM_30*	Grey caulking on interior joints of AHU 44, Roof of Hydraulics	**None Detected**		**100% Other**	Gray, Non Fibrous, Homogeneous / Ashed

Sharon Donald (30)

Analyst

Approved Signatory

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1512662
Analysis ID: 1512662_PLM
Date Received: 6/29/2015
Date Reported: 7/2/2015

Project: Public Works Government Sevices Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0029A *1512662PLM_1*	Drywall joint compound on wall, Wildlife Services, Room R115	**None Detected**		**100% Other**	White Non Fibrous Heterogeneous Teased
0029B *1512662PLM_2*	Drywall joint compound on wall, Wildlife Services, Corridor near exterior Vestibul	**None Detected**		**100% Other**	White Non Fibrous Heterogeneous Teased
0029C *1512662PLM_3*	Drywall joint compound on wall, Water Survey Copy Room	**None Detected**		**100% Other**	White Non Fibrous Heterogeneous Teased
0030A *1512662PLM_4*	Brown mastic on ductwork in fan unit, Office L521A	**3% Chrysotile**		**97% Other**	Red Non Fibrous Homogeneous Ashed
0030B *1512662PLM_5*	Brown mastic on ductwork in fan unit, Office L529	**Not Analyzed**			
0030C *1512662PLM_6*	Brown mastic on ductwork in fan unit, Office L532A	**Not Analyzed**			
0031A *1512662PLM_7*	Brown baseboard mastic, Office L529	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous Dissolved
0031B *1512662PLM_8*	Brown baseboard mastic, Office L529	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous Dissolved

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Byron Stroble (18)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1512662
Analysis ID: 1512662_PLM
Date Received: 6/29/2015
Date Reported: 7/2/2015

Project: Public Works Government Sevices Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0031C *1512662PLM_9*	Brown baseboard mastic, Office L529	**None Detected**		**100% Other**	Brown Non Fibrous Heterogeneous Dissolved
0032A *1512662PLM_10*	Black caulking over clear silicone on Penthouse wall, Roof of A&L	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0032B *1512662PLM_11*	Black caulking over clear silicone on Penthouse wall, Roof of A&L	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0032C *1512662PLM_12*	Black caulking over clear silicone on Penthouse wall, Roof of A&L	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0033A *1512662PLM_13*	Brown caulking at the base of railing, Roof of A&L at Penthouse	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0033B *1512662PLM_14*	Brown caulking at the base of railing, Roof of A&L at Penthouse	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0033C *1512662PLM_15*	Brown caulking at the base of railing, Roof of A&L at Penthouse	**None Detected**		**100% Other**	Brown Non Fibrous Homogeneous Ashed
0034A *1512662PLM_16*	Black caulking at steel beam, A&L Mechanical Penthouse beside Elevator Room	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed

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Byron Stroble (18)

Analyst

Approved Signatory

P-F-002 r15 1/15/2018

Bulk Asbestos Analysis

By Polarized Light Microscopy
EPA Method: 600/R-93/116 and 600/M4-82-020

AIHA LAP, LLC ACCREDITED LABORATORY INDUSTRIAL HYGIENE ISO/IEC 17025:2005 LAB #173190

NVLAP Lab Code: 200664-0

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1512662
Analysis ID: 1512662_PLM
Date Received: 6/29/2015
Date Reported: 7/2/2015

Project: Public Works Government Sevices Canada, CCIW, 867 Lakeshore Road, Burlington, Ontario

Sample ID *Lab Sample ID*	Description *Lab Notes*	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes Treatment
0034B *1512662PLM_17*	Black caulking at steel beam, A&L Mechanical Penthouse beside Elevator Room	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed
0034C *1512662PLM_18*	Black caulking at steel beam, A&L Mechanical Penthouse beside Elevator Room	**None Detected**		**100% Other**	Black Non Fibrous Homogeneous Ashed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Byron Stroble (18)

Analyst

Approved Signatory

Bulk Asbestos Analysis
by Transmission Electron Microscopy

NY ELAP: 198.4

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Damian Palus
Leslie Cantar

Project: 97138.001 PWGSC

Lab Order ID: 1512680
Analysis ID: 1512680_TOF
Date Received: 6/29/2015
Date Reported: 7/6/2015

Sample ID	Description	Organic	Acid Sol.	Asbestos	LCL-UCL
Lab Sample ID	*Lab Notes*	*(Wt. %)*	*(Wt. %)*	*(Wt. %)*	*(Wt. %)*
0035	**12" x 12" vinyl floor tile, white with grey flecks, Kitchenette in Wildlife Services**	**3.6%**	**94%**	**No Asbestos Detected**	
1512680TOF_1					

Ired Gulley (1)

Analyst

Approved Signatory

APPENDIX II-B

Lead Analytical Certificates

Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy
EPA SW-846 3050B/6010C/7420

AIHA LAP, LLC ACCREDITED LABORATORY ENVIRONMENTAL LEAD ISO/IEC 17025:2005 www.aihaaccreditedlabs.org LAB #173190

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1509441
Analysis ID: 1509441_PBP
Date Received: 5/15/2015
Date Reported: 5/21/2015

Project: 97138.001 PWGSC 867 Lakeshore Road Burlington DSUB

Sample ID *Lab Sample ID*	Description *Lab Notes*	Mass *(g)*	Concentration *(ppm)*	Concentration *(% by weight)*
L015 1509441PBP_1	Yellow paint on pipes at AHU 27, Third Floor Mechanical Room	0.0524	160000	**16%**
L016 1509441PBP_2	Green paint on AHU 27, Third Floor Mechanical Room	0.0667	140000	**14%**
L017 1509441PBP_3	White paint on steel beam, Hydraulics Mezzanine Level at AHU 43	0.0646	2700	**0.27%**
L018 1509441PBP_4	Grey paint on metal exterior of AHU 44, Roof of Hydraulics	0.0596	100	**0.010%**
L019 1509441PBP_5	Grey paint on metal exhaust for AHU 44, Roof of Hydraulics	0.0677	< 59	**< 0.006%**
L020 1509441PBP_6	White paint on steel column supporting Mezzanine, Hydraulics Open Area near Lab H158	0.0596	< 67	**< 0.007%**
L021 1509441PBP_7	Black paint on exterior metal cladding, Roof at WTC Penthouse	0.0501	270	**0.027%**

Unless otherwise noted blank sample correction was not performed on analytical results. Scientific Analytical Institute participates in the AIHA IHPAT program. IHPAT Laboratory ID: 173190. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. Analytical uncertainty available upon request. The quality control samples run with the samples in this report have passed all EPA required specifications unless otherwise noted. RL: (Report Limit for an undiluted 50ml sample is 4µg Total Pb).

Daniel Olson (7)
Analyst

Laboratory Director

Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy
EPA SW-846 3050B/6010C/7420

AIHA LAP, LLC ACCREDITED LABORATORY
ENVIRONMENTAL LEAD
ISO/IEC 17025:2005
www.aihaaccreditedlabs.org
LAB #173190

Customer: Pinchin Ltd.
11-875 Main St West
Hamilton Ontario L8S 4R9

Attn: Leslie Cantar
Damian Palus

Lab Order ID: 1512620
Analysis ID: 1512620_PBP
Date Received: 6/29/2015
Date Reported: 7/2/2015

Project: 97138.001 PWGSC 867 Lakeshore Road Burlington DSU

Sample ID *Lab Sample ID*	Description *Lab Notes*	Mass *(g)*	Concentration *(ppm)*	Concentration *(% by weight)*
L022 1512620PBP_1	Off-white paint on drywall wall, Wildlife Services, Room R115	0.0387	< 100	**< 0.010%**
L023 1512620PBP_2	Rose paint on drywall wall, Wildlife Services, Meeting Room	0.0565	85	**0.008%**
L024 1512620PBP_3	Off-white paint on drywall wall, Water Survey Copy Room	0.0802	63	**0.006%**
L025 1512620PBP_4	Off-white paint on plaster wall, Office L521A	0.0283	320	**0.032%**
L026 1512620PBP_5	Black paint on metal fan unit, Office L529	0.0102	17000	**1.7%**
L027 1512620PBP_6	Black paint on steel beam, A&L Mechanical Penthouse	0.0286	16000	**1.6%**
L028 1512620PBP_7	Black paint on metal cladding, Exterior of A&L Mechanical Penthouse	0.0247	1600	**0.16%**

Unless otherwise noted blank sample correction was not performed on analytical results. Scientific Analytical Institute participates in the AIHA IHPAT program. IHPAT Laboratory ID: 173190. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. Analytical uncertainty available upon request. The quality control samples run with the samples in this report have passed all EPA required specifications unless otherwise noted. RL: (Report Limit for an undiluted 50ml sample is 4µg Total Pb).

Daniel Olson (7)

Analyst | **Laboratory Director**

APPENDIX III
Methodology

1.0 GENERAL

Pinchin conducts a room-by-room survey (rooms, corridors, service areas, exterior, etc.) to identify the hazardous building materials as defined by the scope.

Information regarding the approximate quantity, location, and condition of hazardous building materials encountered and visually estimated quantities are recorded. The locations of any samples collected are recorded on small-scale plans.

As-built drawings and previous reports are referenced where provided.

1.1 Limitations on Scope

The assessment excludes the following:

- Owner or occupant articles (e.g. stored items, furniture, appliances, etc.);
- Underground materials or equipment (e.g. vessels, drums, underground storage tanks, pipes, etc.);
- Building envelope, structural components, inaccessible or concealed materials or other items where sampling may cause consequential damage to the property.
- Energized systems (e.g. internal boiler components, elevators, mechanical or electrical components);
- Controlled products (e.g. stored chemicals, operational or process-related substances); and
- Materials not typically associated with construction (e.g. settled dust, spills, residual contamination from prior spills, etc.).

The assessment includes limited demolition of wall and ceiling finishes (drywall or plaster) to view concealed conditions at representative areas as permitted by the current building use. Limited destructive testing of flooring is conducted where possible (under carpets or multiple layers of flooring). Demolition of masonry walls (chases, shafts etc.), structural items or exterior building finishes is not conducted.

1.2 Asbestos

Pinchin conducts an inspection for the presence of friable and non-friable asbestos-containing materials (ACM). A friable material is a material that when dry can be crumbled, pulverized or powdered by hand pressure.

A separate set of samples is collected of each type of homogenous material suspected to contain asbestos. A homogenous material is defined by the US EPA[1] as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material. The homogeneous materials are determined by visual examination, available information on the phases of the construction and prior renovations.

Pinchin collects samples at a rate that is in compliance with Table 1 of O.Reg. 278/05.

The sampling strategy is also based on known ban dates and phase out dates of the use of asbestos; sampling of certain building materials is not conducted after specific construction dates. In addition, to be conservative, several years past these dates are added to account for some uncertainty in the exact start/finish date of construction and associated usage of ACM.

In some cases, manufactured products such as asbestos cement pipe are visually identified without sample confirmation.

Pinchin conducts limited demolition of masonry block walls (core holes) to investigate for loose fill insulation. The core holes are temporarily patched with expanding foam.

Flooring mastic/adhesive and leveling compounds are only sampled and analyzed if present on the underside of flooring samples (vinyl floor tile and vinyl sheet flooring).

Pinchin submits the bulk samples to a NVLAP[2] accredited laboratory for analysis. The analysis is performed in accordance with Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, July 1993.

The asbestos analysis is completed using a stop positive approach. Only one result of greater than or equal to the regulated criteria (0.5%) is required to determine that a material is asbestos-containing, but all samples must be analyzed to conclusively determine that a material is non-asbestos. The laboratory stops analyzing samples from a homogeneous material once a result greater than the regulated criteria is detected in any of the samples of that material. All samples of a homogeneous material are analyzed if no asbestos is detected. In some cases, all samples are analyzed in the sample set regardless of result. Where building materials are described in the report as non-asbestos, or described as containing no asbestos, this is subject to the limitations of the analytical method used, and should be understood to mean no asbestos was detected.

1 Environmental Protection Agency
2 National Voluntary Laboratory Accreditation Program

Asbestos materials are evaluated in order to make recommendations regarding remedial work. This includes friability, condition and efficiency and practicality of the work.

1.3 Lead

Pinchin collects samples of distinctive paint finishes and surface coatings present in more than a limited application, where removal of the paint is possible. Pinchin collects samples by scraping the painted finish to include base and covering applications. Drawings included show sample locations.

Analysis for lead in paints or surface coatings is performed in accordance with EPA Method No. 3050B/Method No. 7420; flame atomic absorption at an accredited laboratory.

For this report, all paints containing lead at a concentration of 0.009% or greater are discussed. Paint and surface coatings are evaluated for condition.

Lead building products (e.g. batteries, lead sheeting, flashing) are identified by visual observation only.

1.4 Silica

Pinchin identifies building materials suspected of containing crystalline silica (e.g. concrete, cement, tile, brick, masonry, mortar) by knowledge of current and historic applications and visual inspection only. Pinchin does not perform sampling of these materials for laboratory analysis of crystalline silica content.

1.5 Mercury

Building materials/products/equipment (e.g. thermostats, barometers, pressure gauges, light tubes), suspected to contain mercury were identified by visually inspection only. Dismantling of equipment suspected of containing mercury was not performed. Sampling of these materials for laboratory analysis of mercury content was not performed.

Mercury spills or damaged mercury-containing equipment was recorded where observed.

1.6 Polychlorinated Biphenyls

Pinchin determines the potential for light ballast and wet transformers to contain PCBs based on the age of the building, a review of maintenance records and examination of labels or nameplates on equipment, where present and accessible. The information is compared to known ban dates of PCBs and Environment Canada publications.

Dry type transformers are presumed to be free of dielectric fluids and hence non-PCB.

Pinchin records spills or leakage of suspect PCB-containing fluids where observed or identified in historical documents.

Fluids (mineral oil, hydraulic or Askarel) in transformers or other equipment are not sampled for PCB content.

Pinchin decides to sample exterior caulking or sealants for PCBs based on the date of construction or installation. Caulking installed after 1985 is presumed to be free of PCBs and hence not sampled. If sampled, analysis for PCBs is performed using an ASTM[3] test method appropriate to the sample matrix at an accredited laboratory.

1.7 Ozone Depleting Substances (ODS)

Pinchin determines the potential presence of ODS (chlorofluorocarbon, hydrochlorofluorocarbon, hydrofluorocarbon, halon, etc.) in air conditioning units, chillers, commercial coolers and fire suppression systems by visual inspection of manufactures' labels or plates, maintenance records, or log books, etc.

Domestic type equipment such as window mounted and small central air conditioners, refrigerators, and freezers are not evaluated for the presence of ODS.

1.8 Visible Mould

Pinchin identifies the presence of mould if visibly present in a significant quantity on exposed building surfaces. If any mould growth is concealed within wall cavities it is not addressed in this assessment.

1.9 Others

The remaining hazardous materials required to be reviewed included the following:

- Ozone-depleting substances
- Urea formaldehyde foam insulation
- Fuel, oil and/or waste oil storage
- Chemical storage
- Hazardous film or residue within the ducts
- Radioactive materials

The review of these materials only included a visual inspection. Pinchin heavily relied on the information provided by the Client for radioactive materials and chemical storage areas, and chemicals used in the Labs which can create hazardous films or residue within ducts.

[3] American Society for Testing and Materials

APPENDIX IV

Photographs

Non-asbestos grey putty at pipe penetrations into AHU 27, Third Floor Mechanical Room

Asbestos-containing brown mastic on ductwork in fan unit, Fifth Floor Office L529

MMM GROUP

COMMISSIONING PLAN

CCIW - Labs, AHUs And Heating Upgrade

Project Number: 8914167-000

Revision No.: 0

Date: 7 July 2015

Prepared by: MMM Group Limited
100 Commerce Valley Drive West, Suite 500
Thornhill, Ontario
L3T 0A1

LIST OF CONTENTS

Part 1 SUMMARY

1.1 COMMISSIONING

- Commissioning is the Quality Assurance process of moving the facility from the 'static completion' to the optimal 'dynamic' operating state by verifying, through testing, that the systems are performing as per the design intent and that they meet the Owner's operational needs.
- The Commissioning Plan provides the details for the implementation of the commissioning process:
  - .1 outlines and describes the commissioning process and the objectives of the commissioning
  - .2 identifies the members of the commissioning team and their roles and responsibilities in the commissioning process
  - .3 documents the commissioning process for future references in operating and maintaining the facility
  - .4 schedules the commissioning activities for testing, verification and training of O/M staff

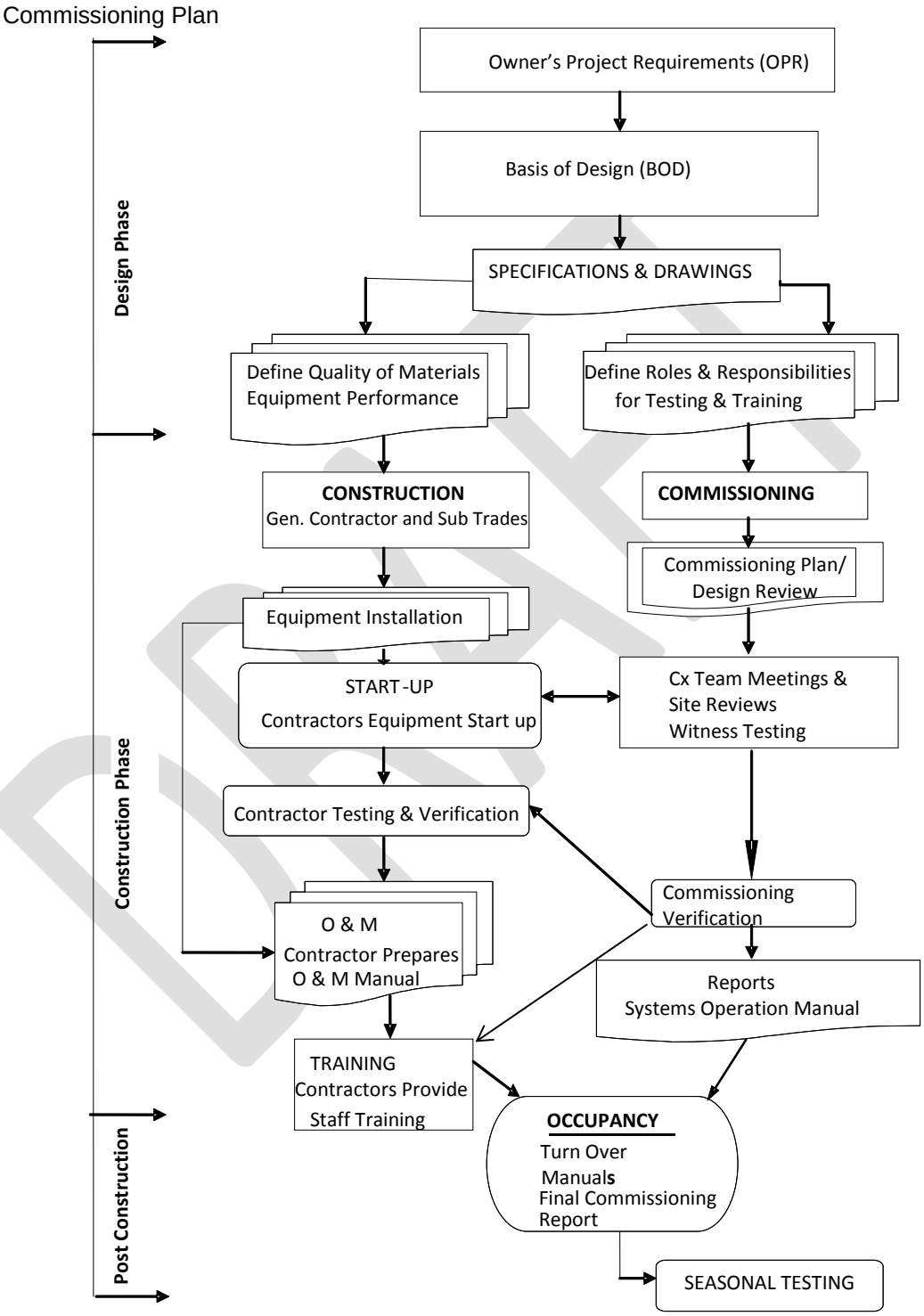
Part 2 OBJECTIVES

2.1 GENERAL

- Support quality management through monitoring and checking of the installation
- Verify system performance through testing and commissioning of the completed installation
- Move the completed facility from the 'static completion' state to the optimal 'dynamic' operating state
- Optimize operating and maintenance through delivery of comprehensive quality training and instruction to the Owner's operating personnel
- System debugging and optimization
- Completion of testing and verification through seasonal review

Part 3 COMMISSIONING PROCESS OUTLINE SUMMARY

3.1 COMMISSIONING PROCESS FLOW CHART



3.2 DESIGN PHASE

- Commissioning requirements are developed and incorporated into the contract document.
- Commissioning plan is being developed.
- The Owner's Project Requirements (OPR) is established by the Owner and the Basis of the Design (BOD) is provided by the Engineer of Record.
- Review of the design development documents at specific stages.
- Review of the tender documents.
- Commissioning Plan is being updated.

3.3 CONSTRUCTION PHASE

- Contractor's submittals are being reviewed.
- The Commissioning Plan is being updated.
- Commissioning meetings are scheduled with the commissioning team to review the commissioning plan and schedule.
- Equipment start-up and testing dates are established and incorporated into the construction schedule.
- Review of the installation progress and pre-functional checklist.
- Review start–up procedures and witness equipment start up.
- Review contractor's and independent third party test reports.
- Develop/ Review functional testing and verification procedures and implementation of the procedures.
- Test the functional performance of the systems to verify compliance with the design intent.
- Review the requirements of the operational and maintenance manuals.
- Review the procedures of the orientation and training of the operation and maintenance staff. Schedule the training of the maintenance staff.
- Review the equipment and systems warranty.
- Prepare the final commissioning report.

3.4 POST-COSTRUCTION PHASE

- Schedule off-season functional performance test and report on the findings;
- Review the systems with the operational staff at the prior to end of the warranty period.

Part 4 COMMISSIONING TEAM CONTACT INFORMATION

4.1 GENERAL

- Commissioning team Contact Information specific for this project is located in Appendix A.

Part 5 ROLES AND RESPONSIBILITIES

5.1 CLIENT (PWGSC)

- Define the OPR.
- Provide operating personnel to attend training and instruction regarding specific components, equipment and systems.
- Retain the services of independent third parties for system verification and certification as required in the contract document or by applicable codes.
- Observe onsite installation, start up and testing of equipment and systems as noted in the specification/ contract document.

5.2 CONSULTANT (DIALOG)

- Define the Basis of the Design (BOD) to meet the Owner's Project Requirements.
- Prepare the design document outlining the project requirements.
- Review and approve the contractor's submittals, such as shop drawings to ensure compliance with the specifications requirements.
- Review contractor's installation program to ensure that the installation sequences have been coordinated with the project schedule.
- Monitor, check and inspect the installation throughout the construction stages, as required, to ensure the equipment installation meets the required expectation as noted in the specification and drawings.
- Inspect the systems installation and issue deficiencies reports, as required.
- Review operating and maintenance manuals, balancing and test reports and as-built drawings for accuracy.
- Witness equipment start-up and tests, as required.
- Confirm completion of contractor's installation and commissioning work.

5.3 COMMISSIONING AUTHORITY (MMM COMMISSIONING)

- Review the design and tender document and provide feedback to the commissioning team with emphasis on testing, commissioning, operation and maintenance of the proposed system and equipment.
- Review the contractor's submittals such as shop drawings and reports for commissioning related issues.
- Prepare the commissioning plan based on the contractor's schedule and installation method statement.
- Review the installation during the construction stage and issue deficiency reports on commissioning perspective.
- Supervise the commissioning and review contractor's proposed commissioning schedule.
- Distribute reports noting any issues that may have an impact on the commissioning of the equipment or system.
- Attend construction site meetings as required to discuss commissioning related items and any impact on project schedule.
- Set-up and chair commissioning meetings as required.
- Identify issues that might be a concern for successful commissioning of the systems and discuss with commissioning team for a resolution.
- Witness and conduct functional performance tests with assistance from the contractor.
- Work with the project team to resolve any problems that may arise during the commissioning phase.
- Coordinate training and instructions provided by manufacturers and suppliers. Recommend additional training and/or instruction of operating and maintenance personnel deemed necessary over and above that already provided.
- Provide final commissioning report recommending acceptance and conditional acceptance.
- Prepare the seasonal performance test program and conduct tests with assistance from the contractors.

5.4 CONTRACTOR

- General
  - .1 To manage and ensure entire installation complies with requirements of the Contract Documents.
  - .2 Submit shop drawings complete with Contractor's Stamp of Review.
  - .3 Submit working detail (interference or installation) drawings, as required.
  - .4 Complete testing and commissioning forms.
- Submit an installation schedule. This schedule shall include:
  - .1 Major equipment delivery and factory testing dates.
  - .2 Coordinated installation activities and sequences in compliance with the General Contractor's project schedule and other trade's installation schedule.
- Submit a commissioning schedule. This schedule shall include:
  - .1 Time schedule for system and equipment commissioning which complies with the timing and sequences of installation schedule stated above. In this schedule, allow additional time for testing and commissioning, such that performance of the re-test of the equipment can be done in a timely manner, if required, without impact to the overall project schedule or delay to Project completion.
  - .2 Indicate dates in the schedule for completion of required factory tests prior to equipment delivery to the site.
  - .3 Prepare and submit testing and commissioning method statements for review and approval.
  - .4 Prepare and submit testing and commissioning record or report forms for review and approval.
  - .5 Attend progress and commissioning meetings.
  - .6 Rectify or replace reported deficiencies and defects promptly.
  - .7 Retain manufacturers and/or independent third parties to provide service for testing and certification of the systems where required by codes and/or specification, as well as training of Owner's personnel.
  - .8 Provide training and instruction to the Owner's operating personnel.
  - .9 Perform testing and commissioning of equipment and systems to the satisfaction of the Consultant and Commissioning Authority. The Commissioning Authority, as required, will witness testing and commissioning. Contractor or his retained agents shall also record procedures and findings in reviewed test and record forms. Submit test and record forms with the signature of the tester for review by the Consultant and Commissioning Authority.
  - .10 Pay for and be responsible for all inspections required by codes, specification and Authorities having Jurisdiction as required. Obtain and submit all Certificates of Approval for such inspections and verifications.
  - .11 Submit for review, as-built drawings including those for location of control devices, wiring and operating and maintenance manuals for each piece of equipment as per the specification requirements.
  - .12 Provide Operating and Maintenance Manuals for review by the Consultant and Commissioning Authority with all the testing and commissioning results and reports incorporated.
  - .13 Submit warranties for equipment and systems to the Owner as required by the specification.
  - .14 Provision of all necessary test equipment for testing and commissioning shall be the responsibility of the contractor. Provide a recently validated calibration certificate for all equipment to be used for verification prior to testing and commissioning commencement.

.15 Complete all commissioning procedures and activities, and performance verification procedures that were delayed or not concluded during the commissioning phase.

.16 Complete system checks post-construction as required by specification. Conduct seasonal tests/ deferred testing for heating and cooling systems as required and determined.

.17 Rectify all deficiencies revealed by these checks. Equipment manufacturers involved in commissioning shall participate in systems checks.

.18 Revise all “as-built” and operating and maintenance documents to reflect all changes, modifications, revisions and adjustments upon completion of commissioning.

.19 Schedule a question and answer session for the operating and maintenance personnel 3 months after handover of the facility to the Owner. The number of questions or concerns that need to be addressed will dictate the length of the session or sessions.

Part 6 MEETINGS AND SCHEDULES

6.1 MEETINGS

- Site Meetings

  .1 The Commissioning Authority attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in commissioning. The Commissioning Authority shall be included in the distribution list of regular Site Meetings to keep updated.

  .2 The General Contractor will provide the Commissioning Authority with information regarding supplemental instructions, change orders and RFI that may affect the commissioning of equipment, systems, or the commissioning schedule.

- Commissioning Meetings

  .1 Meetings will be scheduled, during design and construction phase, by the Commissioning Authority to include all of the commissioning team members. Those meetings shall address commissioning related responsibilities as well as the preparation for all specified testing, documentation, O&M manuals, training, and post-construction requirements.

6.2 SCHEDULING

- Scheduling

  .1 The Contractor will provide a Commissioning Schedule that should indicate the specific date & time scheduled for start-up & commissioning of all equipment and systems related to the project. Commissioning Authority will review the schedule and provide their comments as required. The schedule may need to be periodically updated depending on the readiness of the system during the construction stage.

Part 7 OUTSTANDING COMMISSIONING ITEMS TRACKING LOG

7.1 GENERAL

- The Commissioning Authority will track all the commissioning related items utilizing the Outstanding Commissioning Items Tracking Log. The log will detail the description of each item, project party required to take action and the current status. The log will be updated as items are addressed by the Commissioning Team. If any of the items are considered deficiencies, the Commissioning Authority will re-verify them only one time after a confirmation has been received that the item has been corrected.

Part 8 SYSTEMS TO BE COMMISSIONED

8.1 GENERAL

- The following is a list of the building mechanical systems to be commissioned for the project:
  - **Fire Protection Systems** – Wet Sprinkler Systems, Standpipe System and Fire Pumps.
  - **Plumbing Systems** – Hot and Cold Domestic Water Systems, Sanitary System, Plumbing Fixtures, and Domestic Hot Water Pumps.
  - **Natural Gas System** – New gas lines for Boilers.
  - **HVAC Systems** – Chilled Water System, Hot Water Heating System i/c Condensing Boilers, Steam System, Heat Exchangers, Humidifiers, Air Handling Units, Packaged Rooftop Unit, Transfer and Exhaust Fans, Chemical Treatment, etc.
  - **Building Automation System** – Control system

8.2 HVAC SYSTEMS

- Air Handling Systems and Roof Top Unit
  - .1 Air handlers c/w associated dampers, filters, heating coils, pre-heat and re-heat coils, heat recovery coil, cooling coils, humidifiers, supply fan, return fan, heat wheels, VFDs, ductwork, variable air volume terminals, fire and smoke dampers and associated instrumentation.
- Hot Water Heating System and Glycol System
  - .1 Condensing Boilers, Heating water circulation pumps, VFDs, piping, heat exchanger, AHU heating coils, pre-heat and re-heat coils, hydronic and steam unit heaters, expansion tank, glycol feed tank, chemical treatment, & associated instrumentation, etc.
- Exhaust Fans / Transfer Fans / Ductwork
  - .1 Fans, ductwork, filters, diffusers, louvres, air terminal units for supply/ general exhaust/ fume hood exhaust, dampers, and associated controls, etc.

8.3 PLUMBING & DRAINAGE SYSTEMS

- Domestic Hot and Cold Water Systems
  - .1 Domestic hot water heater, hot water recirculation pump, domestic cold water system, lab water system, acid neutralizer, lab sink, plumbing fixtures, piping and accessories, etc.

8.4 FIRE PROTECTION SYSTEM

- Fire Protection System
  - .1 Wet sprinkler system, standpipe system, piping and accessories, etc.

8.5 NATURAL GAS SYSTEM

- Natural Gas System
  - .1 Piping, vents, valves & accessories, etc.

8.6 BUILDING AUTOMATION CONTROLS SYSTEM

- Control System
  - .1 Controls sequences, devices, controllers, alarms, trend log, compatibility with existing control system, system integration with other services like lab freezer/ fridges, etc.

Part 9 PERFORMANCE TESTING

9.1 GENERAL

- Commissioning of the systems shall commence once the equipment has been completely installed, started up, tested by the mechanical contractors and manufacturers, and test reports have been submitted for review by the Consultant (Dialog) and Commissioning Authority (MMM Commissioning). The contractors are to indicate in writing when all the requirements have been completed and that the equipment / system is ready for verification. Commissioning Authority (MMM) will verify the performance of all mechanical systems to ensure the systems are properly set up and operate to meet the design intent as noted in the mechanical specification & drawings.

9.2 AIR DISTRIBUTION SYSTEMS

- This section refers to all air related systems such as: Air Handling Systems, Roof Top Unit, Air Terminal Units, Exhaust Fans and Transfer Fans.
- General Requirements
  - .1 Our intent is to conduct functional testing of the equipment and systems with the Contractor and compare the results to the design requirements outlined in the Construction Documents.
  - .2 The start-up of the units (AHUs, RTU & Exhaust Fans) will be performed by the manufacturers' authorized technician and the equipment start-up report is to be forwarded by the Contractor to the Commissioning Authority for review prior to scheduling functional test for the specific unit.
  - .3 The testing of the air handling systems and exhaust/ transfer fans will be performed after the Contractor has provided the BAS point to point verification documentation and the BAS graphics are available at the operator work station. Testing will be performed through adjusting the operating parameters and observing the subsequent equipment / system responses. The purpose of these tests is to verify the point to point operation of the control devices, the programming of the operating sequences and the alarm notification. Once the testing of the individual equipment is complete, it will then be performed for system level testing as well as systems integration testing.
  - .4 Specific and random verifications of the TAB will be conducted to the satisfaction of the Commissioning Authority and Consultant. The objective is to ensure that the TAB reports are accurate and represent the actual conditions of the equipment and that the equipment capacities meet the design criteria.
  - .5 The Contractor is to provide a trend report for all systems at the beginning of the Occupancy phase for a specified period of time. Commissioning Authority will specify exactly which points are to be trended. Trending will be used to evaluate the system performance during the equipment level testing by assessing their abilities to maintain the internal set point parameters. Additionally, trending will be used to evaluate equipment during the integrated system level testing by assessing the ability of equipment and systems to work together to maintain facility set point parameters.
  - .6 The Contractor is to provide a multi-reader with a probe for verifying the calibration of the temperature and humidity sensors in the air systems.
  - .7 The onsite TAB and BAS commissioning of the exhaust and transfer fans is to be performed for all fans.
  - .8 Seasonal verification to be scheduled for equipment and/or systems which require specific outdoor air conditions in order to perform the testing.
  - .9 All equipment is to be started up as per the manufacturers' recommendations.
  - .10 All shop drawings, test reports, manuals, as-built, etc., to be submitted by the Contractor for review by the Consultant and Commissioning Authority.
  - .11 Testing of air related equipment and systems is to be performed under fire alarm mode as part of the integrated system level testing.

.12 Testing of air related equipment and systems is to be performed under emergency power mode as part of the integrated system level testing.

- Specific Requirements for Commissioning of Laboratory Temperature and Pressurization Control System:
  - .1 The performance verification of the temperature and space pressurization control system for all laboratories shall be done to comply with the control sequence noted in the drawing (M6.03).
- Specific Requirements for Commissioning of Electrical Room Ventilation and Temperature Control System:
  - .1 The performance verification of the ventilation and temperature control system for Electrical Room shall be done to comply with the control sequence noted in the drawing (M6.02).
- Specific Requirements for Commissioning of Admin/Meeting Zone Temperature and Pressurization Control System:
  - .1 The verification of the temperature and pressurization control system for the admin/meeting zone shall be done to comply with the control sequence noted in the drawing (M6.02).
- Specific Requirements for Commissioning of Fume Hood Exhaust Air Fan:
  - .1 The performance verification of the fume hood exhaust air fan is to be conducted to comply with the control sequence noted in the drawing (M6.02).
- Specific Requirements for Commissioning of Air Handling Systems:
  - .1 The performance verification of the air handling systems shall be done to comply with the control sequence noted in the drawing (M6.01 & M6.02).
- Specific Requirements for Commissioning of Central Exhaust Air System (EF-4):
  - .1 The performance verification of the fume hood and central exhaust fan (EF-4) shall be done to comply with the control sequence noted in the drawing (M6.01).

9.3 HYDRONIC SYSTEMS

- This section refers to all hydronic related systems such as: Hot Water Heating System, Chilled Water System, and Steam System.
- General Requirements
  - .1 Our intent is to conduct functional testing of the equipment and systems with the Contractor and compare the results to the design requirements outlined in the Construction Documents.
  - .2 The start-up of the units (Condensing Boilers, Pumps) will be performed by the manufacturers' authorized technician and the equipment start-up report is to be forwarded by the Contractor to the Commissioning Authority for review prior to scheduling functional test for the specific unit.
  - .3 The performance verification of the hot water heating system i/c. condensing boilers, pumps, unit heaters, etc. shall be done to comply with the control sequence noted in the drawing (M6.01 & M6.04).
  - .4 The testing of the hydronic system will be performed after the Contractor has provided a BAS point to point verification document and the BAS graphics are available at the operator work station. Testing will be performed through adjusting the operating parameters and observing the subsequent equipment / system responses. The purpose of these tests is to verify the point to point operation of the control devices, the programming of the operating sequences and the alarm notification. Once the testing of the BAS for individual equipment is complete, it will then be performed for system level testing as well as systems integration testing.

.5 Specific and random verifications of the TAB will be conducted to the satisfaction of the Commissioning Authority and Consultant. The objective is to ensure that the TAB reports are accurate and represent the actual conditions of the equipment and that the equipment capacities meet the design criteria.

.6 The onsite verification of the balancing and controls is to be performed for all the pumps.

.7 The Contractor is to provide a day trend report for all systems at the beginning of the Occupancy phase for a specified period of time. Commissioning Authority will specify exactly which points are to be trended. Trending will be used to evaluate the system performance during the equipment level testing by assessing their abilities to maintain the internal set point parameters. Additionally, trending will be used to evaluate equipment during the integrated system level testing by assessing the ability of equipment and systems working together to maintain facility set point parameters.

.8 Seasonal verification to be scheduled for equipment and/or systems which require specific outdoor air conditions in order to perform the testing.

.9 All equipment is to be started up as per the manufacturers' recommendations.

.10 All shop drawings, test reports, manuals, as-built, etc., to be submitted by the Contractor for review by the Consultant and Commissioning Authority.

.11 Contractor to forward water quality report after completion of chemical treatment for the hydronic systems.

.12 Testing of hydronic equipment and systems is to be performed under fire alarm mode as part of the integrated system level testing.

.13 Testing of hydronic equipment and systems is to be performed under emergency power mode as part of the integrated system level testing.

9.4 PLUMBING SYSTEM

.1 The plumbing system includes domestic hot water heaters, domestic hot water recirculation pump, acid neutralizer, lab sinks, plumbing fixtures, domestic and lab water systems, piping and all associated accessories. Our intent is to conduct functional testing of the equipment and systems with the Contractor and compare the results to the design requirements outlined in the Construction Documents.

.2 All equipment is to be started up as per the manufacturers' recommendations.

.3 Complete the pre-operational cleaning for the plumbing systems and provide reports to the Consultant for review.

.4 Plumbing fixtures will be verified on a random sampling basis for hot and cold water flow condition that includes monitoring the hot water temperature.

.5 All verification of the systems is to be done as part of the building automation system control points testing.

.6 All documentation such as water test and pipe test reports, laboratory water analysis, shop drawings, manuals, as-built, etc., to be submitted for review by the Consultant and Commissioning Authority.

9.5 FIRE PROTECTION SYSTEM

.1 Our intent is to witness the Contractor's functional testing of the equipment / systems and the associated controls. The test results will be compared to the design requirements outlined in the construction documents.

.2 Installation of new sprinklers will be verified to ensure the new line is integrated with the existing wet pipe sprinkler system.

9.6 NATURAL GAS SYSTEM

.1 Our intent is to review Contractor's report on completion of the work. A general walkthrough will be made to review the installation.

.2 The system will be tested and certified by the authority having jurisdiction. Contractor to forward us the report issued by the appropriate authority.

.3 Equipment (condensing boilers) served with natural gas will be started-up once the gas line is certified by the appropriate authority.

9.7 BUILDING AUTOMATION CONTROLS SYSTEM

.1 The controls system, including the controllers, control panels, field devices, sensors, portable operator's terminal and workstation will be commissioned at the same time. Our intent is to witness the Contractor's testing of sequences of operation which includes point to point verification and programming.

.2 Controls contractor (Siemens) to verify all points, sensors and sequence of operation. A copy of BAS point to point verification report to be forwarded prior to conducting our performance verification for all systems.

.3 All alarms, trends, etc. to be set by Siemens as noted in the specification. Verification of alarm and trending points will be conducted during system performance testing.

.4 The integration of laboratory freezer/fridge with the BAS will be verified to comply with the control sequence noted in the drawing (M6.01).

.5 Integration/ compatibility of new control system with the existing building control system will be verified to satisfy the design intent.

.6 All documentation such as point-to-point verification list, shop drawings, manuals, as-built, etc., to be submitted for review by the Consultant.

Part 10 TIE-IN WITH EXISTING SERVICES

10.1 GENERAL

- Special requirements are to be noted prior to tie-in with existing mechanical services:
  - **Chilled Water System:** New piping system to be flushed and chemically treated as noted in specification. Laboratory test report certifying acceptable water quality to be forwarded to Consultant and Commissioning Authority for review prior to the tie-in with existing system.
  - **Heating Water System:** New piping system to be flushed and chemically treated as noted in specification. Laboratory test report certifying acceptable water quality to be forwarded to Consultant and Commissioning Authority for review prior to the tie-in with existing system.
  - **Steam System:** New piping system to be thoroughly flushed and cleaned as noted in the specification. Test report certifying acceptable condition of the piping system to be forwarded to Consultant and Commissioning Authority for review prior to the tie-in with existing system.
  - **Fire Piping System:** New piping system to be thoroughly flushed and cleaned as noted in the specification. Test report certifying acceptable condition of the piping system to be forwarded to Consultant and Commissioning Authority for review prior to the tie-in with existing system.
  - **Domestic Water System:** New piping system to be thoroughly flushed and chlorinated treated as noted in specification. Laboratory test report certifying acceptable water quality to be forwarded to Consultant and Commissioning Authority for review prior to the tie-in with existing system.
- A copy of the test reports noted above may be forwarded to the Owner for their review and record prior to connecting new piping system with the existing services.

Part 11 LIST OF TESTING

11.1 GENERAL

- The following is a sample of tests to be completed by the Contractor. Refer to the specifications and the contract document to develop a complete list of the tests required.
  - .1 Pressure testing of piping:
    - .1 drainage and vents
    - .2 domestic hot and cold water
    - .3 heating, steam and chilled water
    - .4 natural gas piping
  - .2 Flushing and cleaning of all pipes.
  - .3 Domestic water lab test.
  - .4 Cleaning and leak testing of ductwork.

Part 12 DOCUMENTATION

12.1 GENERAL

- The sample list of documentation is to be provided by the Contractor, but not limited to the following:
- Refer to the specifications and contract document to develop a complete list of the documentation required.
  - .1 Commissioning schedule
  - .2 Shop drawings
  - .3 Manufacturer start-up reports
  - .4 TAB reports
  - .5 As-built drawings
  - .6 Operation and maintenance manuals
  - .7 Certificates, letters and other documentation from local authorities
  - .8 Warranty

Part 13 TRAINING

13.1 GENERAL

- The Commissioning Authority is to review/evaluate the training process and ensure that the trainees have received the materials and information required to properly operate and maintain the facility.
- Training is to commence once the systems have been commissioned. Arrangement is to be made to have all parties, owner's staff, suppliers, contractors, on site during the training.
- The operations, maintenance manuals, and as-built drawings will be used for training purposes. The contractor is to provide a training agenda outlining the topics to be covered during the training session. Provide handouts of manufacturer operation and maintenance recommendations on the topics to be covered during training session.

Part 14 ACCEPTANCE

14.1 GENERAL

- At the substantial completion stage, the Commissioning Team will report on the commissioning status and make recommendations with respect to the level of completion. When all aspects of commissioning have been completed to the satisfaction of the Commissioning Authority, Consultant and Owner, the team will make recommendations with respect to acceptance.

Part 15 SEASONAL COMMISSIONING PROCESS

15.1 GENERAL

- Seasonal testing will be done to confirm that the systems are operating as per the design intent. The Commissioning Team will visit the site during the first twelve months during the heating and cooling seasons to test the systems.
- The operation of the systems will be reviewed with the facility maintenance staff of the Owner.
- A report with deficiencies and recommendations will be provided to the Owner at the end of each test.

Part 16 Appendix A - COMMISSIONING TEAM CONTACT INFORMATION

OWNER		ADDRESS
Owner		PWGSC
Commissioning Authority		MMM Group Ltd Building Performance
Architect		
Mechanical Engineer		DIALOG
General Contractor		
Mechanical Contractor		
Controls Contractor		
TAB Contractor		

End of section